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ABSTRACT

This report chronicles planning grant activities undertaken by the Lakeshore Technical Institute (LTI) and documents findings of a study to determine the feasibility and costs of extending public and educational programs from the LTI campus in Cleveland, Wisconsin, to surrounding communities. The geographic service area, regional telecommunications needs, a comparison of three technologies, financing plans, and community support and education efforts of the planning phase are examined and summarized in the first section. Three extensive appendices provide detailed information supporting and explaining the findings. Appendices include: details of a survey identifying institutional and organizational needs; a technical feasibility and cost study which examines three technical options in order to make recommendations for a regional communications delivery system; and the proposal narrative which explains the need for the regional system and describes the implementation approach to be taken if the construction grant is awarded. (LMM)

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ED225554

PLANNING GRANT REPORT (A feasibility and engineering study of extending cable TV programming to surrounding communities)

Lakeshore Technical Institute
Cleveland, Wisconsin 53015

July 19, 1982

Funded by PTFP, Department of Commerce, 1981.

The study reported herein was performed pursuant to a grant with the National Telecommunications and Information Administration, D.O.C. Grantees are encouraged to express their judgment in the conduct of the project. Therefore, points of view, findings, or opinions stated do not necessarily represent official Public Telecommunications Facilities Program position or policy and the manuscript has not been subjected to regular editorial review given Department of Commerce staff publications.

Project Cost: $15,000.00

IR010564

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PLANNING GRANT REPORT

The mission of Lakeshore Technical Institute is to provide lifelong vocational, technical, and adult education to all residents in Manitowoc County, Sheboygan County, and Southeastern Calumet County, Wisconsin. In 1981, Lakeshore Technical Institute received a planning grant from the Public Telecommunications Facilities Program at the National Telecommunications and Information Administration to determine the feasibility and costs of extending public and educational programs from the LTI campus in Cleveland, Wisconsin to surrounding communities. LTI has completed all work necessary for submission of a construction grant to PTFP for the first public telecommunications delivery system in this area. This report will chronicle the activities undertaken by LTI under this planning grant and will document the findings. The geographic area of service, regional telecommunications needs, identification of appropriate technologies, financing plans, and community support and education efforts of the planning phase will be examined.

Geographic Area of Service

Study under this planning grant was limited to the service area outlined in the original proposal, shown in Exhibit 1. For purposes of analysis it is possible to look at the LTI service area in three sections:

- Manitowoc County to the North, including Manitowoc, Two Rivers, Mishicot, Reedsville, Valders, and Kiel.

- Sheboygan County to the south, including Sheboygan, Sheboygan Falls, Howards Grove, Elkhart Lake, Plymouth, Oostburg, Cedar Grove, and Random Lake.
- Calumet County to the east, including Chilton, Brillion, and New Holstein.

The area is predominantly rural, with significant numbers of Hispanic and Asian-American residents. It is a fringe area for public television signals from Channel 38 of Green Bay and Channel 10 of Milwaukee. Reception is inadequate for most of the rural communities. Cable television service currently exists only in Two Rivers, Manitowoc, and Sheboygan. Lakeshore Technical Institute in Cleveland is centrally located within this district.

Regional Telecommunications Needs

Under this planning grant, the area's need for advanced telecommunication service was studied. First, areawide education on relevant communications technologies and subjects was undertaken. LTI hosted seminars for regional institutions, area organizations, and private citizens on such topics as cable in the Lakeshore area, community use of and access to telecommunications facilities, and experiences of other communities with local program production and teleconferencing. Included in such educational sessions were actual production and teleconferencing demonstrations.

To follow up these educational efforts, LTI designed a survey to identify actual organizational and institutional telecommunications needs in the three-county region. Appendix 1 provides details of the results of this effort, which revealed several types of information about the area to be served.

The study confirmed a need for specialized programming for non-English-speaking minorities in the area and for special segments of the population such as senior citizens and women. The process revealed a very strong desire for increased localized communications among similar institutions and organizations in the region, as well as the need for local programming alongside educational broadcasting and nonlocal video and films. Local governments, educational institutions, social service providers, nonprofit service organizations, and health care providers all showed interest in producing programs to inform and educate area residents on a variety of topics.

The survey process illustrated that in regards to regional communications, participating institutions and organizations took a broad view of the types of programming and service that could be delivered to people in the region. Though some clearly indicated interest in production of relatively traditional "telecourse" material for the system, nearly all saw increased local programming as a way to involve minorities

and special segments of the population in making, viewing, and learning from television in a way not now possible with current telecommunications services in the area.

The survey suggested design of a flexible telecommunications system with local production facilities to train minorities, women, and other members of the public, in addition to governmental and educational personnel, in the basic television production skills so as to utilize the public telecommunications system to its maximum.

Technical Assessment

LTI conducted an investigation into existing and planned communications systems in the area under the PTFP planning grant. Plans for cable television and low-power television service serving some communities in the three-county area had a positive impact upon LTI's design for comprehensive telecommunications service. LTI was successful in negotiating with cable television systems in Manitowoc and Sheboygan to install two-way microwave interconnects between each of these cities and LTI facilities in Cleveland. The interconnect will expand LTI-originated programming for cable subscribers in Manitowoc, Two Rivers and Sheboygan.

The Educational Communication Board of Wisconsin will carry LTI-originated programming on the low-power television transmitter to be built in Chilton for service to New Holstein, Chilton, Brillion, Kiel, Valders, and Reedsville.

The soon-to-be-activated cable TV interconnects will provide LTI programs to most of those institutional branches which requested them in the regional needs survey (Appendix 1). Of those identified in the survey, 87% of the institutional branches in Manitowoc County and 75% of those in Sheboygan County would be reached. Without further cable or low-power television service, however, the following communities in all three counties would be unserved:

- Calumet County: Chilton, Brillion, New Holstein
- Manitowoc County: Mishicot, Reedsville, Valders, Kiel
- Sheboygan County: Sheboygan Falls, Howards Grove, Elkhart Lake, Plymouth, Oostburg, Cedar Grove, Random Lake

LTI engaged Ralph E. Evans Associates of Thiensville, Wisconsin to recommend various technical options for a regional communications delivery system that covered the greatest percentage of the service area, that had little or no duplication of existing systems, and that was economical. As shown in the technical feasibility and cost study prepared by this firm (Appendix 2), three technical options were examined. The costs and features of each are summarized below:

Option 1 A three-site, one-way ITFS (Manitowoc, Sheboygan, Chilton) with receivers in sixteen locations. Cable system interconnect between Cleveland and Manitowoc and between Cleveland and Sheboygan Falls. Uplinks from Kiel and New Holstein would also be provided by the local cable companies.

Total Option 1 Cost: $634,900

Option 2 Option 1 plus uplink capability for full system two-way interactive links for five major communities (Sheboygan, Plymouth, Manitowoc, Two Rivers, Chilton).

Total Option 2 Cost: $872,400

Option A single OMNI ITFS covering eight communities: Sheboygan, Sheboygan Falls, Plymouth, Howards Grove, Kiel, Valders, Manitowoc, Cleveland. (Chilton and nine receiver locations are deleted.)

Total Option 3 Cost: $272,050

Option 3a Option 3 plus uplinks to three communities.

Total Option 3a Cost: $378,550

Option 1 above recommends a three-transmitter ITFS system that would provide virtually full coverage of the LTI area at a total cost of $634,900. Since 76% of the area population and 72% of the institutions surveyed are in cities which will receive LTI programming via cable, Option #1 would cause undue duplication of existing means of program distribution.

Option 3 would cover an area in which 83% of the population and 90% of the institutions surveyed would be served by cable. Option 3 would not reach isolated areas of Calumet County and would fail to provide service to the rural

Sheboygan County communities of Oostburg, Cedar Grove and Random Lake. In addition, Option 3 would require the new construction of a 450 ft. tower rather than utilizing existing tower space.

Options 2 and 3a propose interactive-return microwave signals from unspecified locations. Although the needs assessment indicated a need for interactive teleconferencing, 71% of these sites are located within Manitowoc, Two Rivers, and Sheboygan which are already connected by two-way microwave to LTI. Calumet County contains 13% of the total institutional branches requiring interactive teleconferencing. The addition of a two-way interconnect between Chilton and LTI would provide a regional teleconference network with interactive sites at the extreme North, South, East and central areas of the region.

Based on the requirements of area coverage, lack of duplication, and cost, the following plan for public telecommunication service was developed (Exhibit 2):

- An ITFS transmitter would be installed in Sheboygan Falls, with ITFS receivers located in schools in each of the rural communities in the area: Kohler, Elkhart Lake, Howards Grove, Plymouth, Sheboygan Falls, Oostburg, Cedar Grove, and Random Lake.

- A two-way microwave interconnect between Manitowoc and Chilton would provide the feed from the low-power transmitter licensed by the ECB, serving Chilton, Oshkosh, Appleton, Brillion, New Holstein, Keil, Reedsville, and Valders. The interconnection would link the distribution hub at LTI with the low-power system via microwave to Manitowoc.

- LTI microwave interconnection with cable systems in Sheboygan, Manitowoc, and Two Rivers would be provided by the cable operators.
- Remote production equipment, switching equipment, and replay equipment would be added to LTI's production facilities to enable greater local production capacity for the regional network.

Applications to the FCC have been made for the ITFS service, microwave interconnects, and a satellite earth station.

Financial Feasibility

The PTFP planning grant has enabled the LTI Board of Education to plan for financial support to implement and maintenance this system should a PTFP Construction Grant be awarded. LTI has allocated 43,750 toward a match for the grant and has increased its 1982/83 budget for staff and operation of the system. Area corporations and organizations have also indicated willingness to provide additional funds and support for programming on the system

In addition, the provision of interconnections with operational cable systems--and the promise of more as other municipalities become cabled--has resulted from general support for the proposed extension of telecommunications services in the region. ECB's financing of their low-power television station in Chilton shows further commitment by participants to cooperation and support of a regional public telecommunications network. Coordination with these telecommunications providers and supporters has been a direct

result of efforts undertaken in this project's planning phase, and has resulted in proposal of a system that is most economical.

Community Participation and Support

During the planning phase, the interest, support, and participation of the community has continued to grow. Interest in the telecommunications service was encouraged through the survey, educational activities, and discussions with many users and beneficiaries of the proposed system. The Telecommmunications Advisory Committee continued throughout the process to provide input on the service priorities, operational policies, and proposed implementation of the system. Participation by minorities and women in this process and through this advisory body have insured that provision will be made for maximum representation of these and other groups' special needs regarding programming, operation of the system, staffing, and training.

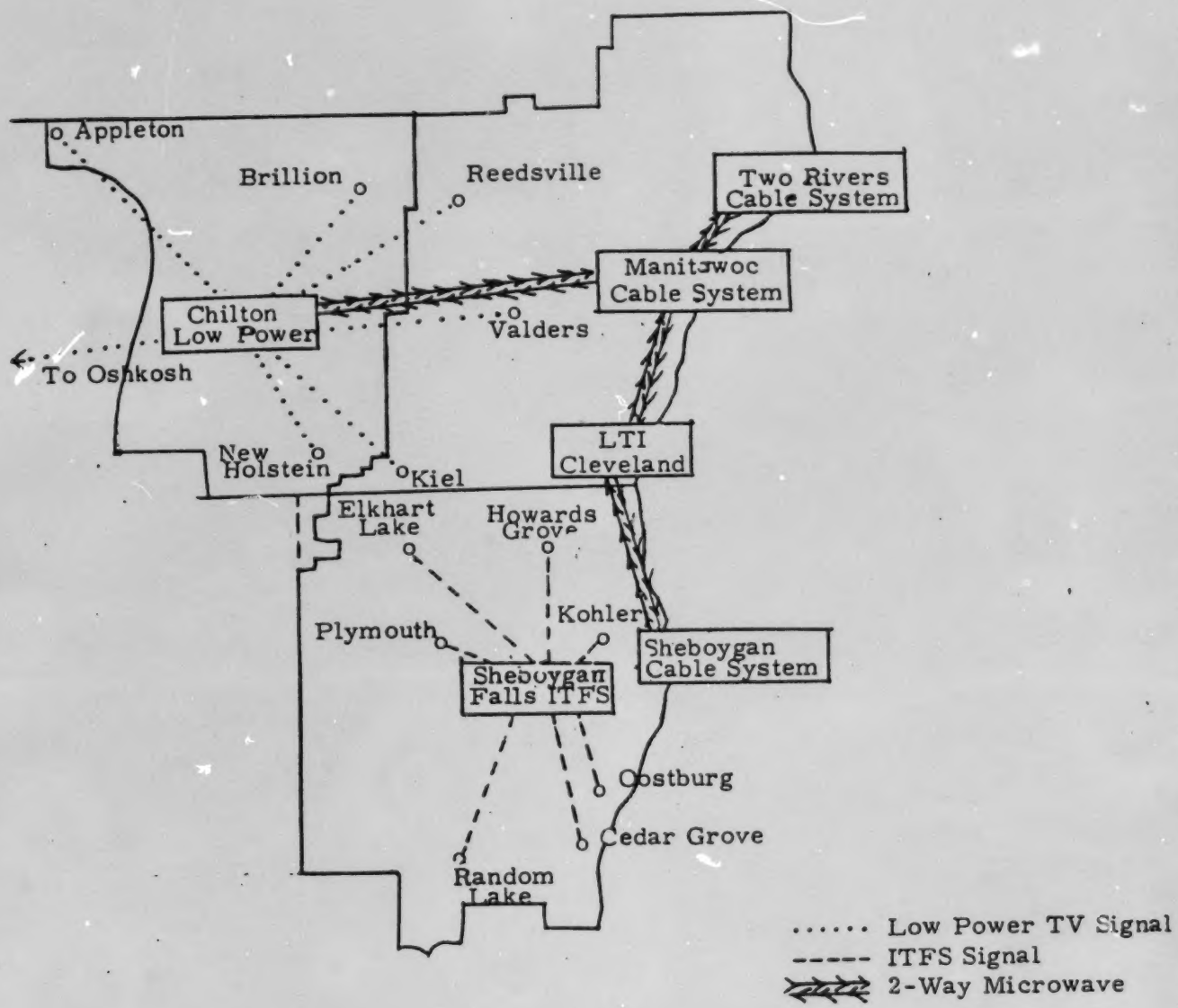
Contact with program suppliers has indicated that there is a tremendous shortage of programs and learning materials for Asian Americans living in rural areas of the U.S. Minorities and women serving on the staff of LTI would thus be responsible for operation of the low-power television station financed by ECB, coordination of regional programming addressing community needs, and training users of the system.

Construction of the System

LTI has completed all tasks needed for submission of a PTFP construction grant. (See Appendix 3.) Pending an award for this project, LTI would be ready to implement a regional telecommunications system immediately--a system that is economically viable and technically compatible with other telecommunications entities operating in and planned for the region.

EXHIBIT 1 -- LOCATION OF TELECOMMUNICATIONS SERVICE

EXHIBIT 2 -- INTEGRATION OF TELECOMMUNICATIONS SYSTEMS IN CALUMET, MANITOWOC, AND SHEBOYGAN COUNTIES, WISCONSIN



APPENDIX I

REGIONAL COMMUNICATIONS NEEDS ASSESSMENT

NEEDS ASSESSMENT REPORT

Introduction

A needs assessment is a determination of the resources and services desired by and useful to an organization in meeting its goals and objectives. Study of articulated communication needs and resources determine the scope of the organization's proposed telecommunication activities and influence the technical design of the communications system. A needs analysis should reveal the potential users and uses and should identify the particular communication needs that exist.

To this end, a written survey designed to identify organizational and institutional needs in the LTI project area was conducted in February 1982. The ascertainment survey represented the culmination of an area educational process that included speakers on such topics as cable in the Lakeshore context, community access, and a demonstration of teleconferencing. The responses received indicate that video and cable use has a definite role to play in reaching minority and special audiences, reaching target audiences, increasing the staff/volunteer capabilities, and increasing the fund-raising success of organizations involved in educational and community services. Thirty-six surveys were completed by representatives of a variety of schools and organizations. (See Exhibit 1.) The results of the ascertainment survey follow.

Users

Most of the institutions surveyed provide educational or community services.

EXHIBIT 1

Participating Organizations

City of Sheboygan
Town of Plymouth
Valders Village Board
Sheboygan Chamber of Commerce
*Sheboygan County Department of Social Services
Comunidad DeAmigos, Inc.
*Mirro Corporation
The Plymouth Review
*Sheboygan Fire Department
*Two Rivers Library
Manitowoc-Calumet Library System
*Joseph Mann Public Library — VHS Recorder only
*Holy Family Hospital
*Memorial Hospital — Video playback only
*Lakeland College
*Lakeshore Technical Institute
*Silver Lake College
VTAE Regional Learning Center
*University of Wisconsin
*Sheboygan Area School District
*Reedsville High School
*Manitowoc Public Schools
*Lincoln High School
*Plymouth Joint School District
Kiel Area Schools
*Valders Public Schools
*School District of Sheboygan Falls
*Elkhart Lake - Glenbeulah Schools
*Howards Grove Schools
*School District of Chilton

*Denotes television production or recording equipment

In statistical terms, the breakdown is:

Education	41%
Community Services	27%
Health	14%
Others	18%

Other institutions need to communicate with branch offices or major facilities located in a different area. Thirty percent of organizations represented in the survey have only one main facility. The remaining need to communicate with from 2 to 26 separate branches scattered throughout the tri-county area. A locational matrix can be found in Exhibit 2.

Surveys revealed a primary interest in reaching a wide, general viewership. In all cases, responses indicate staffs had given thoughtful consideration to involvement in programming.

When asked about the "target audience" for their organization's programming, the breakdown was as follows:

General	69%
Organizational Branch Locations	52%
Organizational Members in Their Homes	27%

Other "target audiences" specifically cited were:

Students	22%
In-service Training	19%

Most programming would be directed toward the general viewing public. Over half of the organizations did have information which they felt would be appropriately delivered to their branch members via cable.

Forty-three percent of those surveyed estimated the hours between 9 a.m. and 3 p.m. to be the most useful for reaching their "target audience."

A detailed matrix follows:

Time Period	Target Audience	Faculty or Staff	General Public	Students or Courses	Members or Patients	Various	Isolated	Total Hours	Percent
7 a.m. - 9 a.m.		6	5	8	4	3	0	26	
9 a.m. - 11 a.m.		5	6	11	8	4	0	35	
11 a.m. - 1 p.m.		4	5	10	6	4	0	29	43%
1 p.m. - 3 p.m.		6	7	11	8	4	0	36	79%
3 p.m. - 5 p.m.		5	11	5	5	4	0	31	55%
5 p.m. - 7 p.m.		6	9	3	6	2	0	26	
7 p.m. - 9 p.m.		6	13	2	4	3	0	28	
9 p.m. - Midnight		3	4	2	3	2	0	14	21%
Midnight - 7 a.m.		3	1	1	3	0	1	9	
TOTALS		44	60	57	47	25	1	234	

From the matrix above, we can infer that the largest "target audience" is the general public with students a close second. We can also infer that the time periods between 9 to 11 a.m., 1 to 3 p.m., and 3 to 5 p.m. will be the most coveted.

Uses

When the institutions surveyed were asked to cite the purposes of their communication activities, the results were:

Specific task or skill training	100%
Dissemination of information	86%
Information exchange	66%
Conferencing or decision making	47%
Client or member feedback	41%

These communication activities can be produced by individual institutions. For example, governmental organizations can transmit local council meetings, public hearings, government activities, and other special programs providing citizens with a chance to become involved in their local government. Educational institutions can offer advantages for nontraditional education like continuing education in the home, office, or factory for the general adult population, professionals, skilled workers, and so on. Local service organizations provide minorities, senior citizens, women, and others with needed services. Possible developments include programming for the English-speaking and non-English-speaking public on subjects like hygiene, first aid, general health, nutrition, emergency procedures, and so on.

It is significant that all institutions surveyed said they had ways that better telecommunications could help them achieve their goals, and they presented plans for the use of the proposed system.

A sampling of their "topic areas" include:

Libraries:	Story Telling Reference Services Community Calendar Introduction of Services
Schools:	Class Courses to Home-Bound Students Seminars for Parent/Teacher/Staff Career Information Special Events School Board Meetings Adult Education In-service for Administrators and Teachers Education for Hispanics Cultural Awareness
Colleges:	Credit and noncredit classes on: Business Science and the Arts Philosophy, Literature, and History Psychology, Political Science Special Events--speakers, seminars, plays, cultural events

Gov't:	Council Meetings and Public Hearings Training Programs Public Relations and Educational Programs for the Public
Others:	The Local News Volunteerism Child Abuse Insurance and Retirement Information Talk Show on Business and Community Issues
Hospitals:	Rehabilitation Programs Health Care and Safety Patient Education Programs

In assessing the technological alternatives which would best fulfill the needs of those surveyed, the responses were:

Two-way video/audio interaction	66%
One-way distribution of video programming	50%
One-way video with audio input from several sites	25%

LTI's proposed delivery system could create a communications link with video, audio, and data carrying capabilities by ensuring institutions the capability to originate live programming by sending a signal back upstream to the main distribution center (LTI's head end) and back out to other institutions or subscribers (downstream).

Facilities and Equipment

Sixty-one percent of those surveyed said their organization already had some television production or record equipment. Many of those responding to this question indicated their equipment had simple playback or record capabilities only. Thirty-three percent said they did not. This distinction is noted in Exhibit 1.

The only existing TV production facility in the proposed area is at LTI. Major studio equipment is nine years old and needs to be upgraded. In addition, portable equipment is needed to tape situations on locations that cannot be duplicated in a studio; i.e., hospital situations, family situations.

According to the survey results, the greatest problems in meeting organizational communications needs are:

Shortage of resource persons	55%
Scheduling	44%
Travel distance	41%

A large portion of the work force has not been able to upgrade its skills and education because of rigidly scheduled classes. The present educational delivery system requires travel by instructors and learners to the main campus or one of the rural centers for instruction. Under this system, it is difficult to find a sufficient number of instructors who will travel to the rural centers, especially during the winter months. Furthermore, many residents are deprived of opportunities, particularly educational pursuits, merely because they are too busy earning a living or providing domestic functions. Still other residents are disadvantaged by illness, language, poverty, or old age.

Conclusion

Many local community groups can be utilized as resources to provide public telecommunication services. The proposed system will greatly enhance institutional efforts to provide alternative cost-effective delivery systems for educational and community services especially to residents in rural areas. Furthermore, it will more effectively utilize each local community's participation in education and related activities.

System flexibility must be maintained to accommodate new services as they become available. All new services need time to develop and will require channel space.

There is also a need for an upgraded facility to train minorities, women, and other members of the public, in addition to governmental, educational, and industrial personnel in the basic TV production skills so they can fully utilize their local access and educational channels of the telecommunications system.

APPENDIX 2

TECHNICAL FEASIBILITY STUDY

RALPH E. EVANS ASSOCIATES
Tele Communications Engineers

LAKESHORE TECHNICAL INSTITUTE

PROPOSED ITFS SYSTEM

FEASIBILITY STUDY AND COST ESTIMATE

April, 1982

RALPH E. EVANS ASSOCIATES
Tele Communications Engineers

FEASIBILITY STUDY FOR AN

EDUCATIONAL MICROWAVE DISTRIBUTION SYSTEM

LAKESHORE TECHNICAL INSTITUTE
CLEVELAND, WISCONSIN

This Engineering study was prepared by Ralph E. Evans III, of Ralph E. Evans Associates Consulting TeleCommunications Engineers in Thiensville, Wisconsin on behalf of Lakeshore Technical Institute in Cleveland, Wisconsin. The purpose of this study is to describe three possible alternatives, and their APPROXIMATE COSTS, for delivery of instructional television program material to several Wisconsin communites. These programs are to originate at studios located in the Lakeshore Technical Building (Figures 10 and 11).

The FCC has established the ITFS service to provide a means for educational institutions to distribute video, computer data, and audio to widely dispersed campuses, schools, and other buildings. One of the principle advantages of an ITFS system is its relative low cost at the receiving locations. Generally, an omnidirectional antenna is used for transmitting the ITFS signals, although some directionality may be used to avoid placing power over unwanted terrain, such as large lakes.

The instant study has concluded that five separate components of the LTI ITFS/Microwave system must be properly intergrated in order that the best cost/benefit be realized:

1) Use must be made of IN PLACE 2-way Cable TV where applicable.

2) One transmit site (Option #3) or three transmit sites (Option #1) should be used for the ITFS antennas.

3) Links must be established for each transmit site so that the program material can be delivered to it from Cleveland.

4) Dish-type receive stations must be installed at all schools or other buildings which are to receive the ITFS signals.

5) For Option #2, transmit stations are to be installed at selected receive locations to provide an uplink feed.

One cautionary note is in order: the costs listed herein are based upon prices in effect as of this writing, normal soil and working conditions, and tower sites as shown in Figure 3 with the heights shown in Figures 5, 6, and 7. It is entirely reasonable to assume that at the time of construction, different tower locations will be used which will affect both the tower costs and the microwave equipment costs. In spite of this uncertainty, it is believed that the prices quoted herein represent a fair

and median value which, under average conditions, will not be exceeded. NO allowance has been made for future inflation, however.

USE OF IN-PLACE CABLE SYSTEMS

For all options except #3, the Lakeshore Campus will communicate with the two primary ITFS transmit stations at Manitowoc and Sheboygan Falls by means of two-way cable. Both of these communities have cable systems installed at the present time, although it is expected that short feeders will have to be run to the tower sites, and to the LTI studio. It is important that these connections be TWO-WAY, since remote control monitoring will be accomplished via this link. LTI will need to lease the equivilent of one TV channel upstream, and one TV channel downstream on each of these cable systems. An advantage of this technique would be the ability to place different programming on the Manitowoc transmitter than is placed on the Sheboygan Falls transmitter.

Because of terrain anomalies, it is not practical to install ITFS receive stations within the communities of Kiel and New Holstein. Consequently, it is herein proposed to utilize ONE-WAY cable FROM Chilton TO Kiel and New Holstein in order to provide these last two communities with the video transmitted at the Chilton site. The receive location at Chilton would simultaneously demodulate the ITFS microwave, and re-modulate it onto the cable for an upstream feed to the cable head end, where it would be put on a downstream channel for distribution. Option #2 would require that these cable links be TWO-WAY.

FREQUENCIES TO BE USED AND DISTRIBUTION PLAN

It is recommended that the following plan be adopted for the distribution of programs in the Lakeshore Technical District, in order that maximum flexibility, interactivity, and cost effectiveness be realized:

According to a frequency coordination conducted by this firm, the ITFS cluster "G" is available for use in the required area, as per Section 74.902 of the FCC's Rules and Regulations:

Channel G-1 = 2644-2650 GHz.
Channel G-2 = 2656-2662 GHz.
Channel G-3 = 2668-2670 GHz.
Channel G-4 = 2680-2686 GHz.

These channels would be allocated as follows:

G2 : Sheboygan Omni Site
G3 : Manitowoc Omni Site
G4 : Chilton Cardioid Site
G1 : Used for point-to-point program origination purposes. This would be the upstream link from local schools to the omni sites in those areas where upstream cable connections are not available (Option #2 only).

If, for any reason, sufficient cable channels are not available at locations designated herein as requiring them, point-to-point microwave can be used to accomplish the desired link (Channel G1).

DESCRIPTION OF NETWORK PLAN

The Sheboygan Falls site will use an ANDREW 63013 or equal, with 13 db omnidirectional gain (Figure 30). The initial application will specify a 10 watt transmitter, although it is anticipated that higher power will be required later in order to adequately serve Random Lake and Elkhart Lake with a noise-free picture.

The Manitowoc site will use an ANDREW 63013 or equal, with 13 db omnidirectional gain. The initial application will specify a 10 watt transmitter, although it is anticipated that higher power will be required later in order to adequately serve Reedsville and Mishicot with a noise-free picture. A second 10 watt transmitter at this site, operating on the same frequency, will feed an 8 foot dish, with a gain of approximately 31 db, in order to provide programming to the Chilton site. It is possible that the final configuration will result in a 12 MHz. microwave link being substituted here for the Chilton feed; however, the cost impact is not significant. This decision is best left to construction engineering.

The Chilton site will utilize an ANDREW P10F-25 or equal receive antenna to pick up the programming from Manitowoc. The transmitter will initially be 10 watts, although higher power will probably be required later to adequately serve Kiel and Brillion with a noise free picture. The transmit antenna will be a cardioid beamed to the east with 18.2 db gain (ANDREW 62351 or equal).

To implement Option #2, the three transmit sites will employ several dish-type RECEIVE antennas, to pick up local origination programming from the sector schools for transmission throughout the system. The individual schools will utilize either a 12 MHz. or 2.6 MHz. antenna for the upstream link.

FEED PLAN

Manitowoc (Sector 1) Feeds:

Manitowoc
Two Rivers
Cleveland
Valders
Reedsville
Mishicot

Sheboygan Falls (Sector 2) Feeds:

Sheboygan
Sheboygan Falls

RALPH E. EVANS ASSOCIATES
Tele Communications Engineers

Oostburg
Cedar Grove
Random Lake
Plymouth
Howards Grove
Elkhart Lake

Chilton (Sector3) Feeds:

Chilton
New Holstein
Kiel
Brillion

Figures 28 and 29 detail antennas which can be used for microwave links, including recommended low-wind-resistance antennas. Existing towers may be used for each ITFS transmit site, but the antenna mounting heights listed in Figures 14, 15, and 16 must be observed. The vertical plans of Figures 5, 6, and 7 are for use in evaluating tower loading. It should be noted that the use of a torque Arm stabilizer is mandatory except on self-supporting towers (provided they are rated for the required load).

RECEIVE FACILITIES REQUIRED AT EACH SECTOR LOCATION

Figure 9, attached, is a diagram of a typical receive location. Reference should be made to Figures 14 through 16 so as to determine the above-ground heights required in the various communities. It should be noted that a change in the transmit tower locations from those assumed in this engineering exhibit may affect the receiving heights, although this effect will be small for nominal departures in geographic coordinates.

THE THREE OPTIONS AND THEIR COSTS

OPTION #1 consists of a three-site ITFS system, covering 16 commjnities. All programming originates from the Cleveland studio.

OPTION #2 adds the ability to originate programming from 5 selected receive locations.

OPTION #3 Deletes two transmit sites, and locates ONE ITFS tower on the LTI campus to serve 7 of the larger southeast Wisconsin communities, at a corresponding decrease in cost.

Figure 27, attached, details these options and the budgetary costs therefor.

This Exhibit Respectfully Submitted,

Ralph E. Evans III Consulting Radio Engineer
April, 1982

ATTACHED FIGURES

Figure 1 - - - - - - - - - Geographical Area
2 - - - - - - - - - County Locator Map
3 - - - - - - - - - Aeronautical Chart Showing Proposed Tower Sites
4 - - - - - - - - - Approximate Service Radius from ITFS sites
5 - - - - - - - - - Manitowoc Tower Vertical Plan
6 - - - - - - - - - Sheboygan Falls Tower Vertical Plan
7 - - - - - - - - - Chilton Tower Vertical Plan
8 - - - - - - - - - Diagram of Torque Arm Assembly
9 - - - - - - - - - Vertical plan of average receive site
10 - - - - - - - - - LTI campus plat showing proposed tower for Option #3
11 - - - - - - - - - Lakeshore Campus Photo
12 - - - - - - - - - Community Populations
13 - - - - - - - - - Calculations of Signal Reliability
14 - - - - - - - - - Manitowoc Profile Evaluations
15 - - - - - - - - - Sheboygan Profile Evaluations
16 - - - - - - - - - Chilton Profile Evaluations
17 thru 26 - - - - Profile Graphs
27 - - - - - - - - - Budgetary Cost Estimates
28 - - - - - - - - - Recommended low-wind-load antennas
29 - - - - - - - - - Antenna specifications (link)
30 - - - - - - - - - Antenna specifications (ITFS)
31 - - - - - - - - - Waveguide Specifications

FIGURE 1

GEOGRAPHICAL AREA
LAKESHORE DISTRICT
manitowoc
cleveland
sheboygan
milwaukee
madison

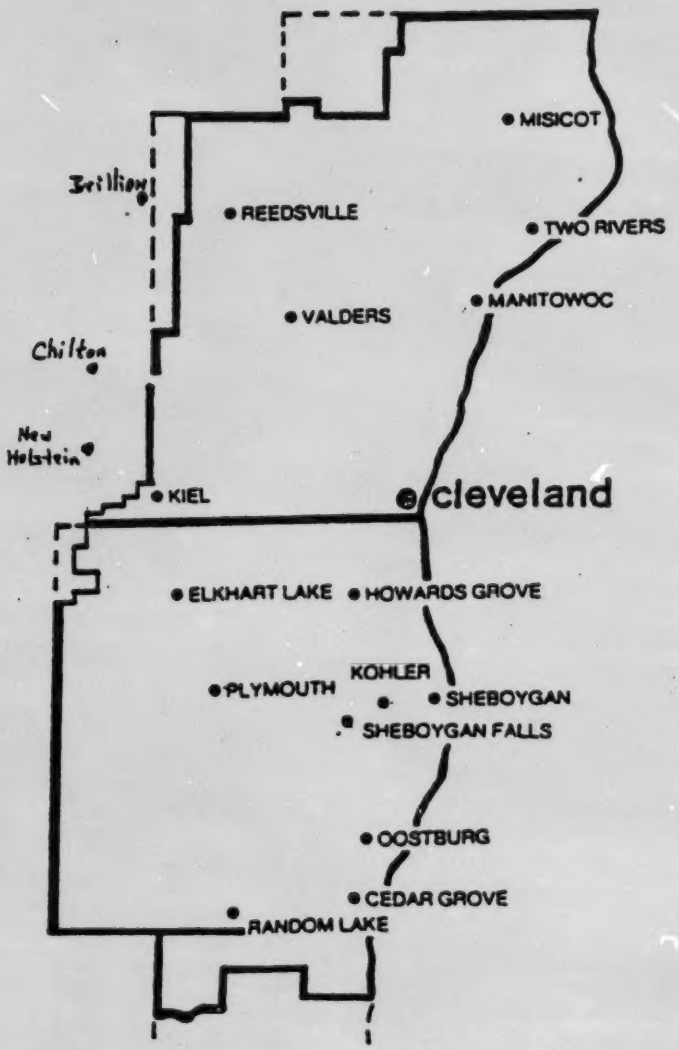
FIGURE 2

COUNTY LOCATOR MAP SHOWING

COMMUNITIES WITHIN WHICH SERVICE IS

DESIRED

LAKESHORE TECHNICAL INSTITUTE



0 5 10 miles (approx)

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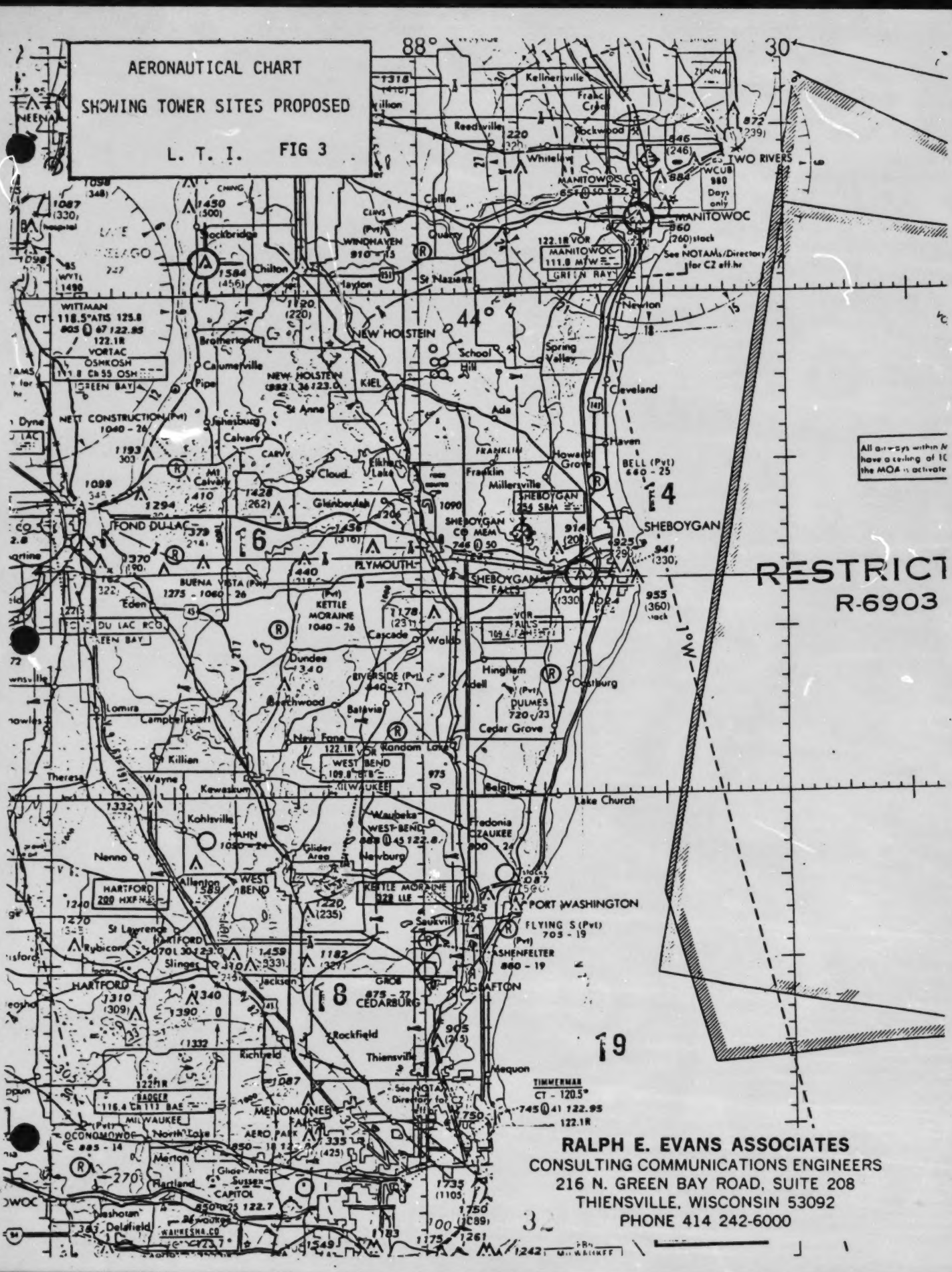
AERONAUTICAL CHART
SHOWING TOWER SITES PROPOSED
L. T. I. FIG 3
RESTRICT
R-6903
SHEBOYGAN
MANITOWOC
TWO RIVERS
PORT WASHINGTON
GRAFTON
CEDARBURG
FOND DU LAC
PLYMOUTH
KIEL
NEW HOLSTEIN
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CONTOUR INTERVAL 50 FEET
MISHICOT
BRILLION
REEDSVILLE
Two Rivers
MANITOWOC
VALDERS
CHILTON
MANITOWOC SITE
CHILTON SITE
NEW HOLSTEIN
KIEL
CLEVELAND
HOWARDS GROVE
ELKHART LAKE
PLYMOUTH
SHEBOYGAN
SHEBOYGAN FALLS
SHEBOYGAN SITE
OOSTBURG
CEDAR GROVE
RANDOM LAKE
MAP SHOWING APPROXIMATE SERVICE RADIUS FROM THE RECOMMENDED ITFS SITES
FIGURE 4
PROPOSED LAKESHORE TECHNICAL ITFS SYSTEM
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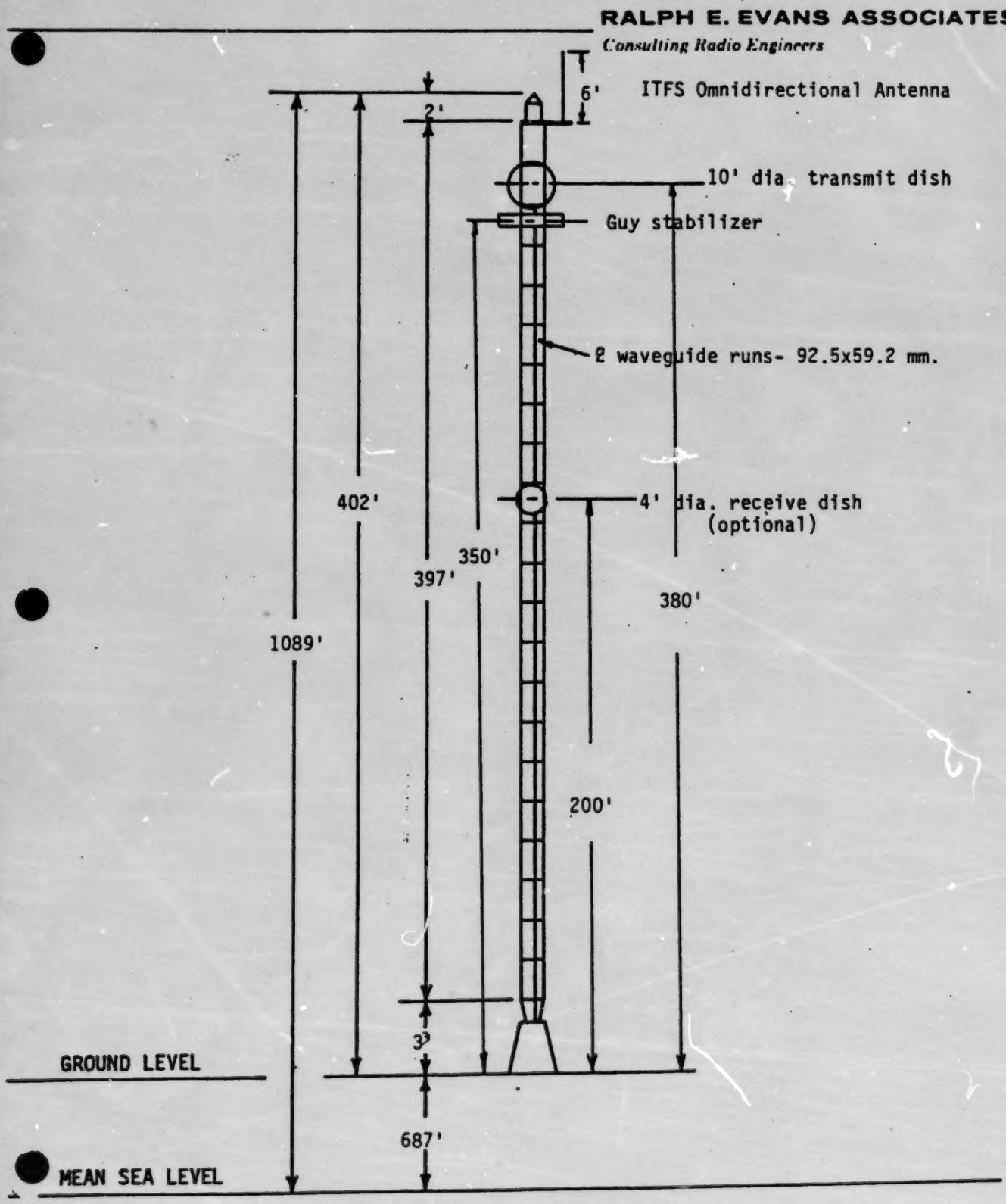
PHONE 414 242-6000
87°-30'-00"
43°-30'-00"

FIGURE 5



VERTICAL PLAN OF MANITOWOC TOWER
LAKESHORE TECHNICAL INSTITUTE PROPOSED ITFS SYSTEM

FIGURE 6

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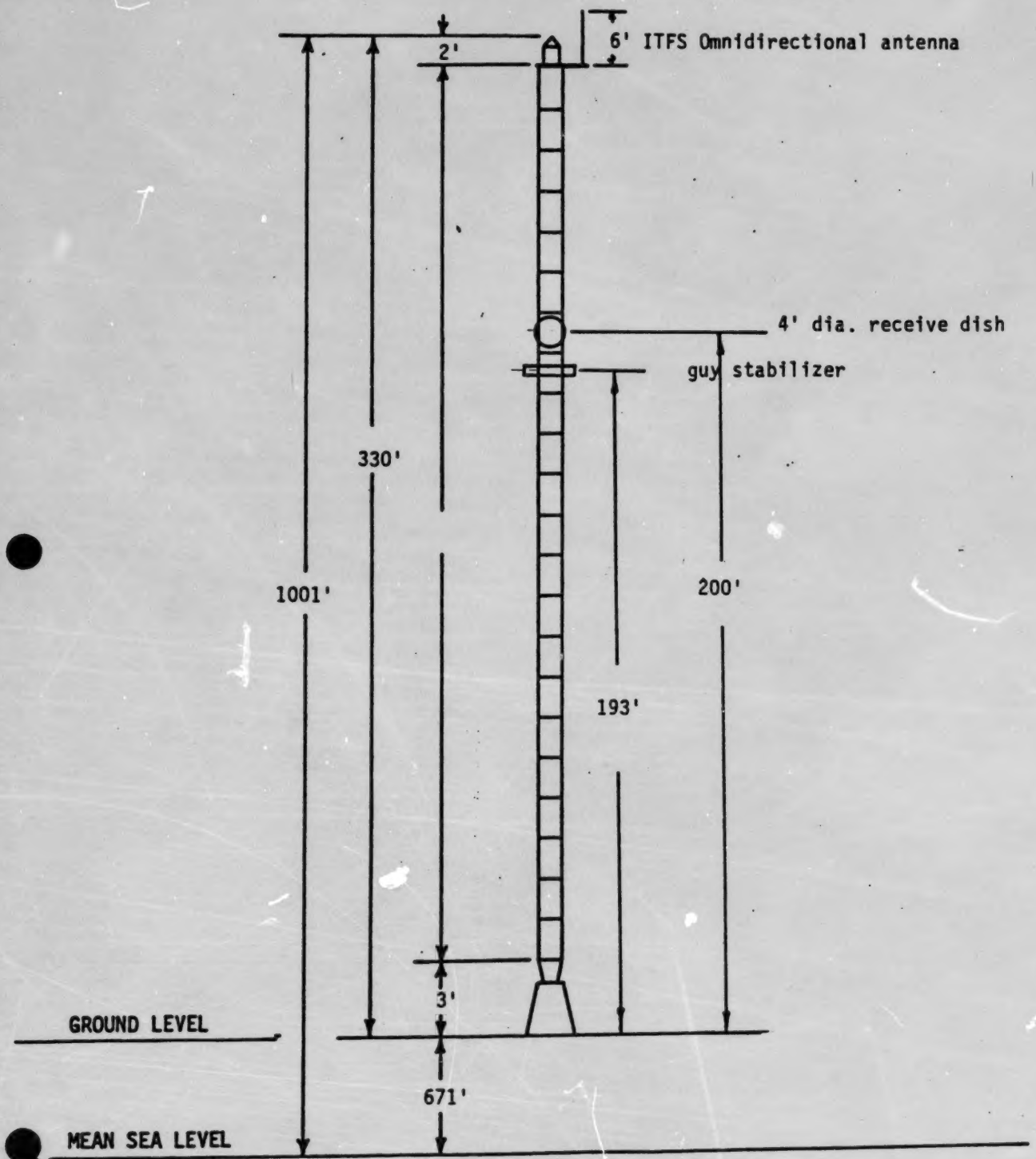
Consulting Radio Engineers



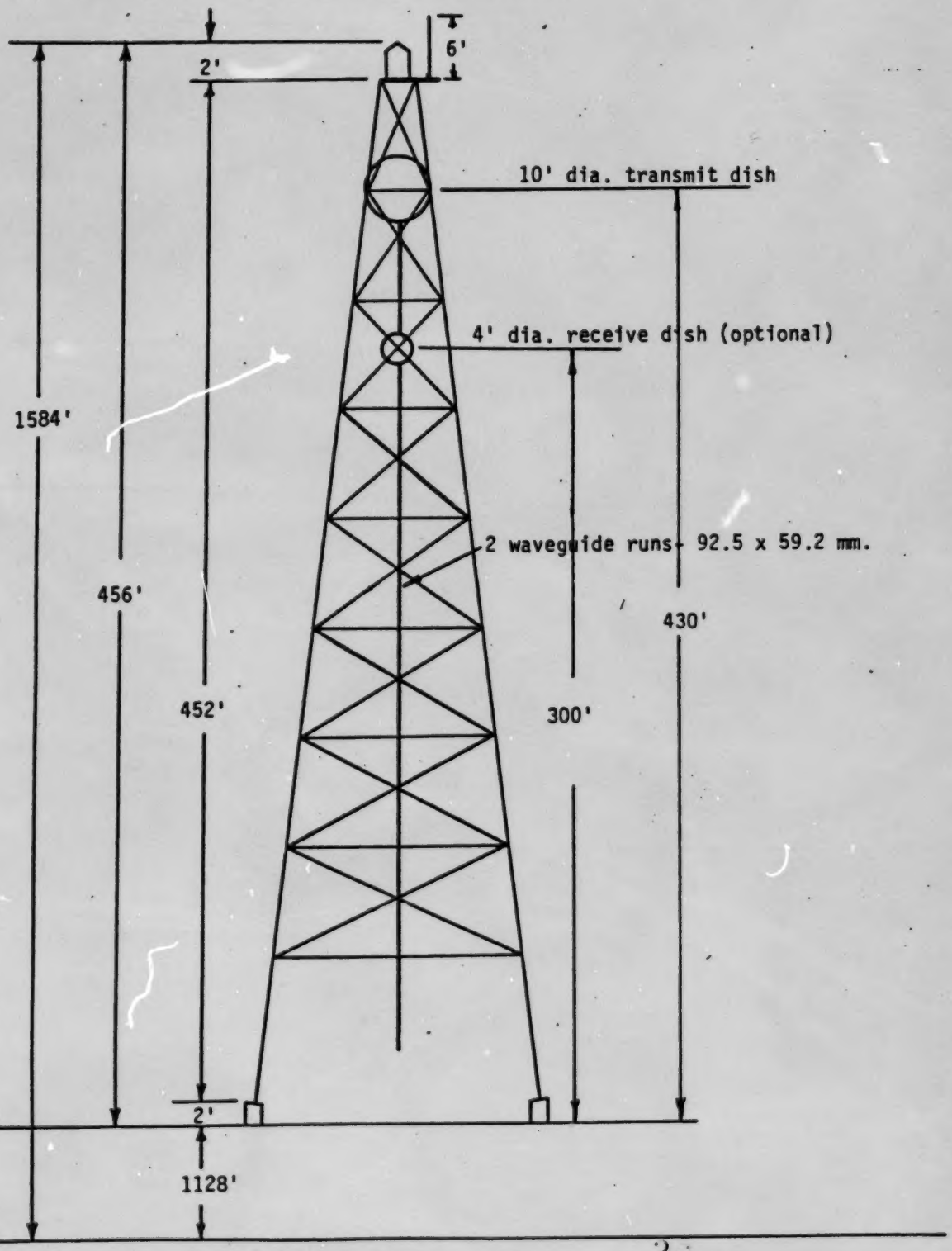
LAKESHORE TECHNICAL INSTITUTE PROPOSED ITFS SYSTEM

VERTICAL PLAN OF SHEBOYGAN FALLS TOWER

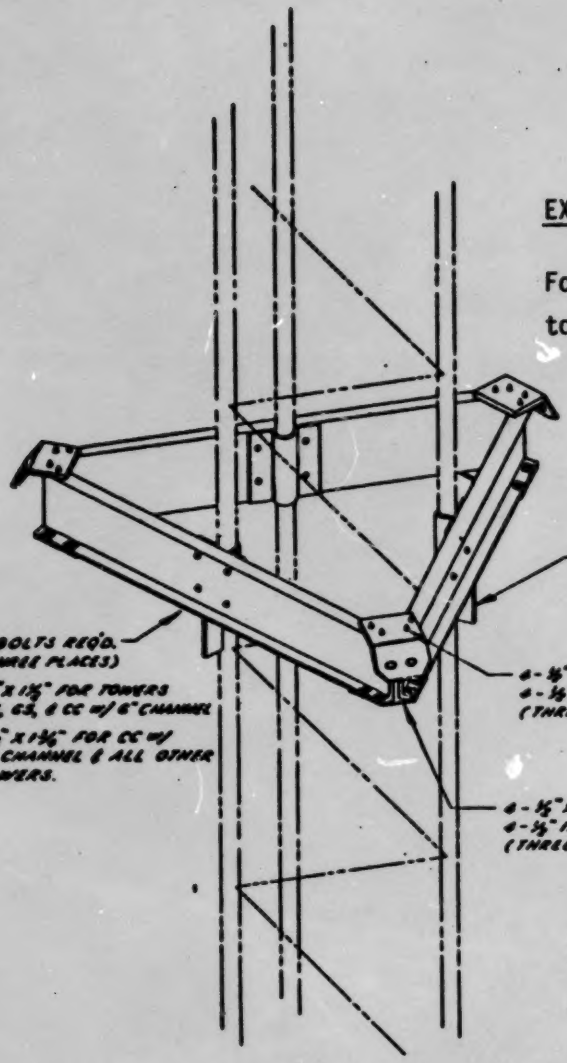
FIGURE 7

RALPH E. EVANS ASSOCIATES
Consulting Radio Engineers

VERTICAL PLAN OF CHILTON TOWER



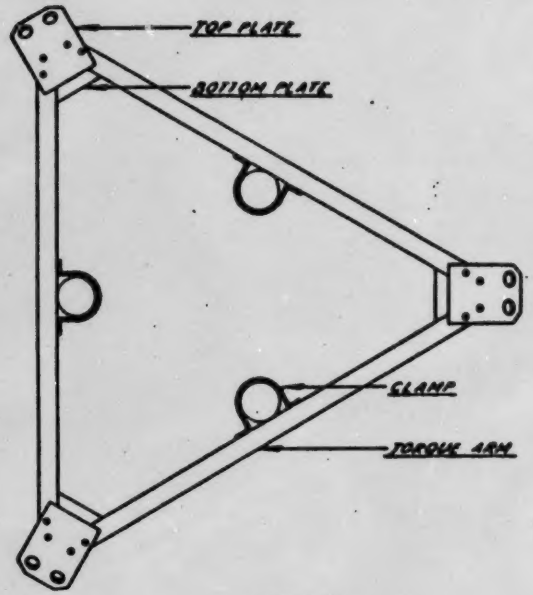
LAKESHORE TECHNICAL INSTITUTE ITFS SYSTEM


TORQUE ARM LUG
(THREE PLACES)
(SEE NOTE 3)
4 BOLTS REQ'D.
(THREE PLACES)
⅝" X 1½" FOR TOWERS
33, 63, & CC w/ 6" CHANNEL
¾" X 1¾" FOR CC w/
8" CHANNEL & ALL OTHER
TOWERS.
6 - ½" X 2" BOLTS WITH
6 - ½" I.D. BEVELED WASHERS
(THREE PLACES)
6 - ½" X 1¾" BOLTS WITH
6 - ½" I.D. BEVELED WASHERS
(THREE PLACES)

TORQUE ARM ASSEMBLY

EXAMPLE TORQUE ARM

For stiffening existing towers at Manitowoc and Sheboygan Falls



PLAN

ELEVATION

NOTES:

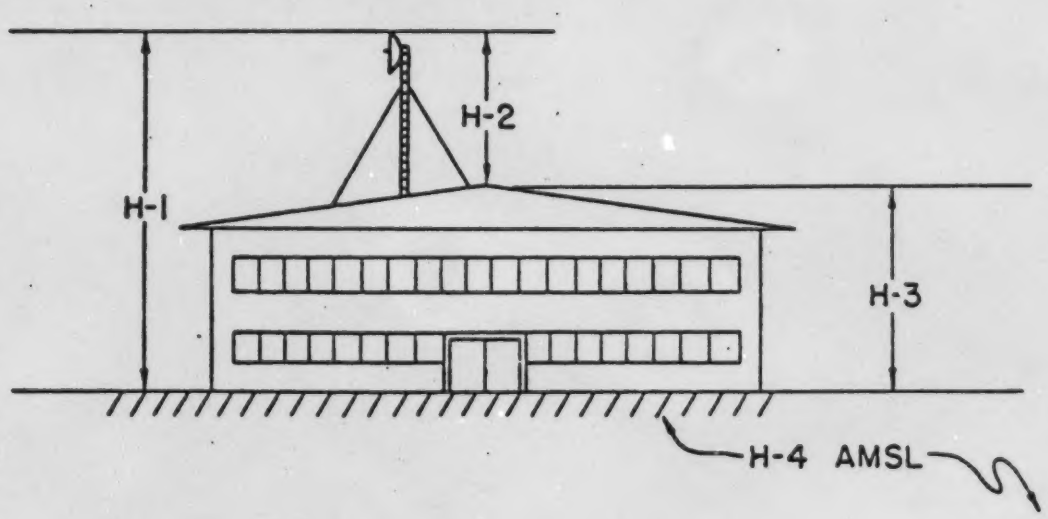
1. ALL BOLTS ARE HIGH STRENGTH.
2. THIS TORQUE ARM IS AVAILABLE FOR TOWER MODELS 33, 63, 82, 83, 84, 85, CC, & DD.
3. TORQUE ARM LUGS ARE PROVIDED FOR TOWERS 33, 63, CC, & DD ONLY. TORQUE ARM BEARS ON BRACE CLIPS ON MODEL 80 TOWERS.

CHANNEL TORQUE ARM ASSEMBLY

I.T.F.S. TOWER

FIGURE 8

H1-ANTENNA ELEVATION A.G.L.
H2-HEIGHT OF ANTENNA ABOVE HIGHEST EXISTING POINT ON SCHOOL
H3-HEIGHT A.G.L. OF HIGHEST EXISTING POINT ON SCHOOL
H4-SITE ELEVATION A.M.S.L.



PUBLIC SCHOOLS

EXHIBIT:
TYPICAL SCHOOL RECEIVING ANTENNA INSTALLATION

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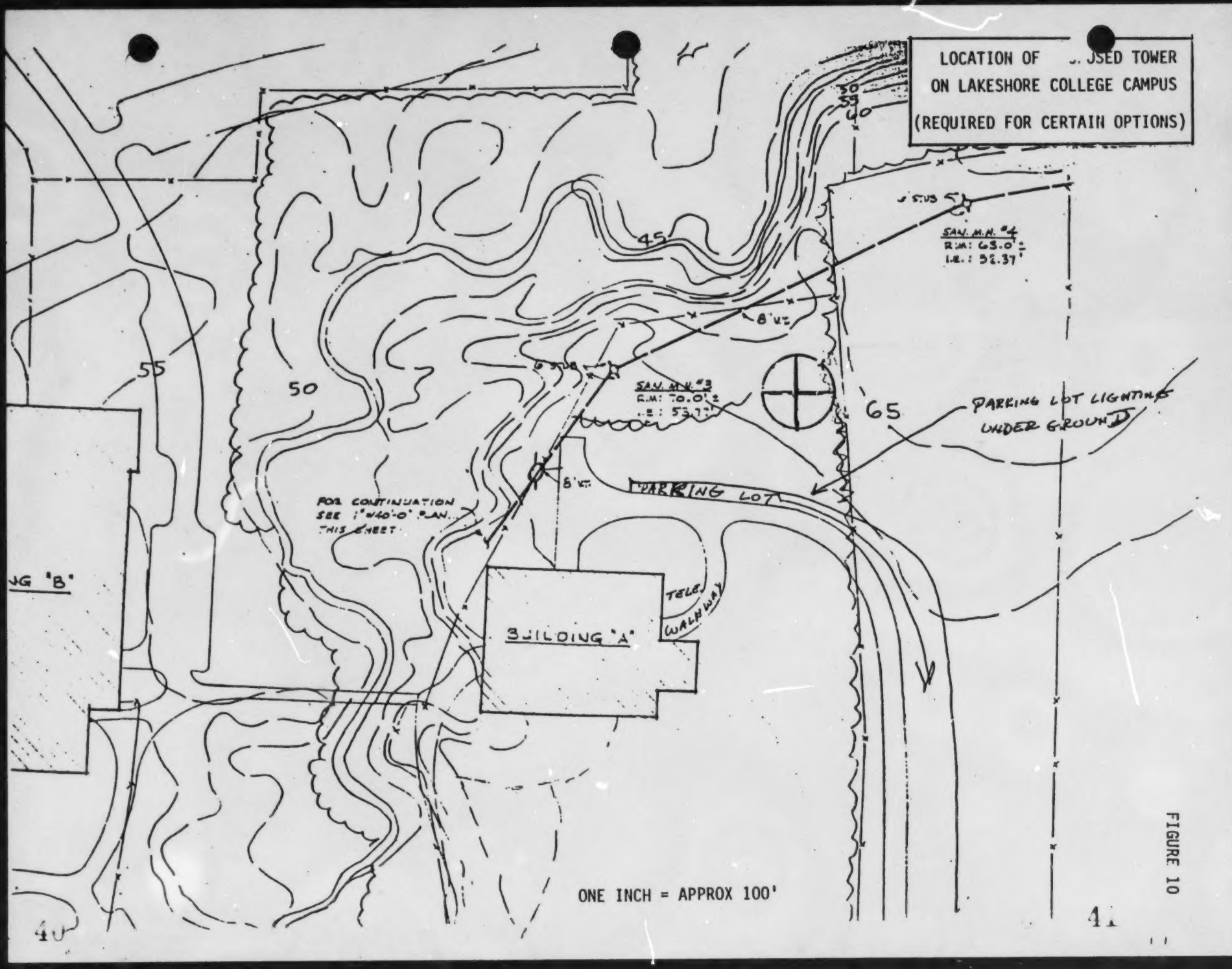
LOCATION OF PROPOSED TOWER
ON LAKESHORE COLLEGE CAMPUS
(REQUIRED FOR CERTAIN OPTIONS)
50
55
40
45
55
50
65
SAN. M.H. #4
R.M.: 63.0±
I.E.: 52.37'
SAN. M.H. #3
R.M.: 70.0'±
I.E.: 53.7'
8" W.
8" W.
PARKING LOT LIGHTING UNDERGROUND
PARKING LOT
FOR CONTINUATION SEE 1"=40'-0" PLAN THIS SHEET
TELE. WALKWAY
BUILDING "A"
BUILDING "B"
ONE INCH = APPROX 100'

FIGURE 10

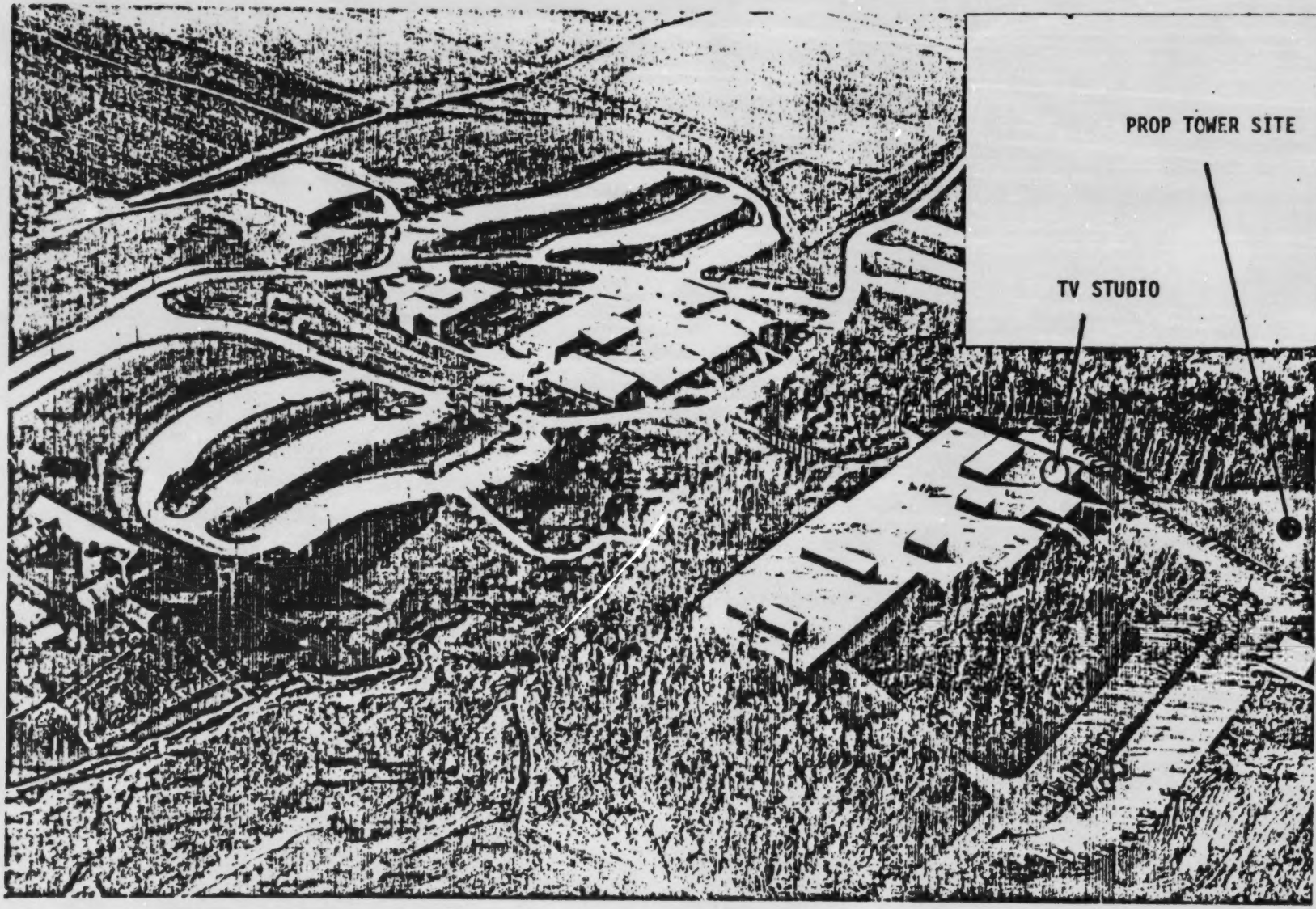

FIGURE 11

LAKESHORE CAMPUS - PHOTOGRAPH SHOWING PROP TOWER SITE

FIGURE 12

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Tele Communications Engineers

1980 POPULATIONS OF COMMUNITIES TO BE SERVED

PROPOSED LTI ITFS SYSTEM

COMMUNITY	POPULATION	
Manitowoc	32,528	Manitowoc Site
Two Rivers	13,339	
Mishicot	1,507	
Reedsville	1,135	
Valders	973	
Cleveland	1,264	
Sheboygan	48,121	Sheboygan F. Site
Sheboygan Falls	5,252	
Plymouth	6,037	
Oostburg	1,651	
Cedar Grove	1,417	
Random Lake	1,283	
Howards Grove	1,843	
Elkhart Lake	1,049	
Brillion	2,919	Chilton Site
Kiel	3,083	
New Holstein	3,426	
Chilton	2,961	

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Tele Communications Engineers

CALCULATION OF SIGNAL RELIABILITY

LAKESHORE TECHNICAL INSTITUTE
Cleveland, Wisconsin

1) Manitowoc Site - Chilton Path (longest link)

a) 29 miles free space loss = -134.5 db @ 2.6 GHz.

b) Transmit Gain = + 35.0 db

c) Receive Gain = + 35.0 db

d) Power Gain = + 10.0 db

e) Fade allowance required for 29 mile path at 2.6 GHz. (99.0% reliability) = - 21.0 db

f) Estimated line loss = - 5.0 db

TOTAL RECEIVER LEVEL WITH FADE = -80.5 db

Signal Strength in Microvolts = 668 microvolts at receiver terminals

Picture quality = 30 db S/N or better 99% of the time

2) Receiver stations (uplink and downlink locations)

Maximum path length = 15 miles, reliability is 99.9% for 30 db S/N for all paths using the facilities listed except:

a) Mishicot path = 95% reliability with 100' tower

b) New Holstein path is not recommended - suggest connection by CATV to Chilton

c) Kiel path is not recommended - suggest connection by CATV to Chilton

d) Random Lake = 90% reliability with 100' tower

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Tele Communications Engineers

LAKESHORE TECHNICAL ITFS

Manitowoc Site

CITY	DIST. FROM TOWER	AZ. FROM TOWER	DISH DIA.	SUPPORT HT.	REMARKS
Mishicot	13.5 mi.	N 14° E	8 ft.	75-100'	Terrain reasonably satisfactory Comm. Elev.: 610-620' AMSL
Two Rivers	10.2 "	N 44° E	6 ft.	50'	No terrain obtructions Comm. Elev.: 890-910' AMSL
Cleveland	9.5 "	N 129° E	6 ft.	50'	No terrain obstructions Comm. Elev.: 650-660' AMSL
Valders	9.2 "	N 276° E	6 ft.	50'	No terrain obstructions Comm. Elev.: 850-860' AMSL
Reedsville	14.3 "	N 300° E	8 ft.	50'	No terrain obstructions Comm. Elev.: 840-860' AMSL
Manitowoc	5.5 "	N 38° E	4 ft	10' clear of bldg. obstr.	No terrain obstructions Comm. elev.: 590-640' AMSL
Chilton	29.0 "	N 267° E	10 ft.	300'	No terrain obstructions

Tower height: 1089' AMSL (400 AGL) 44°-03'-13" 87°-42'-08"

FIGURE 15

RALPH E. EVANS ASSOCIATES
Tele Communications Engineers

LAKESHORE TECHNICAL ITFS

Sheboygan Site

CITY	DIST. FROM TOWER	AZ. FROM TOWER	DISH DIA.	SUPPORT HT.	REMARKS
Sheboygan	5.5 mi.	N 55° E	4 ft.	10' clear of bldg. obstr.	No terrain obstructions Comm. Elev.: 600-650'AMSL
Oostburg	7.6 "	N 185°E	6 ft.	50'	No terrain obstructions Comm. Elev.: 660-680'AMSL
Cedar Grove	11.5 "	N 190°E	8 ft.	50-75'	No terrain obstructions Comm. Elev.: 680-730'AMSL
Random Lake	15.5 "	N 217°E	8 ft.	75'	Terrain not favorable Comm. Elev.: 900' AMSL
Plymouth	11 "	N 282°E	6 ft.	50-75'	No terrain obstructions Comm. Elev.: 800-840'AMSL
Sheboygan Falls	2.2 "	N 290°E	4 ft.	50'	No terrain obstructions Comm. Elev._ 700-720'AMSL
Elkhart Lake	14.5 "	N 305°E	8 ft.	50'	No terrain obstructions Comm. Elev.: 920-940'AMSL
Howards Grove	8.2 "	N 347°E	6 ft.	50'	No terrain obstructions Comm. Elev.: 700-710'AMSL

Tower height: 1001 AMSL (330 AGL) 43°-43'-10" 87°-47'-05"

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Tele Communications Engineers

LAKESHORE TECHNICAL ITFS

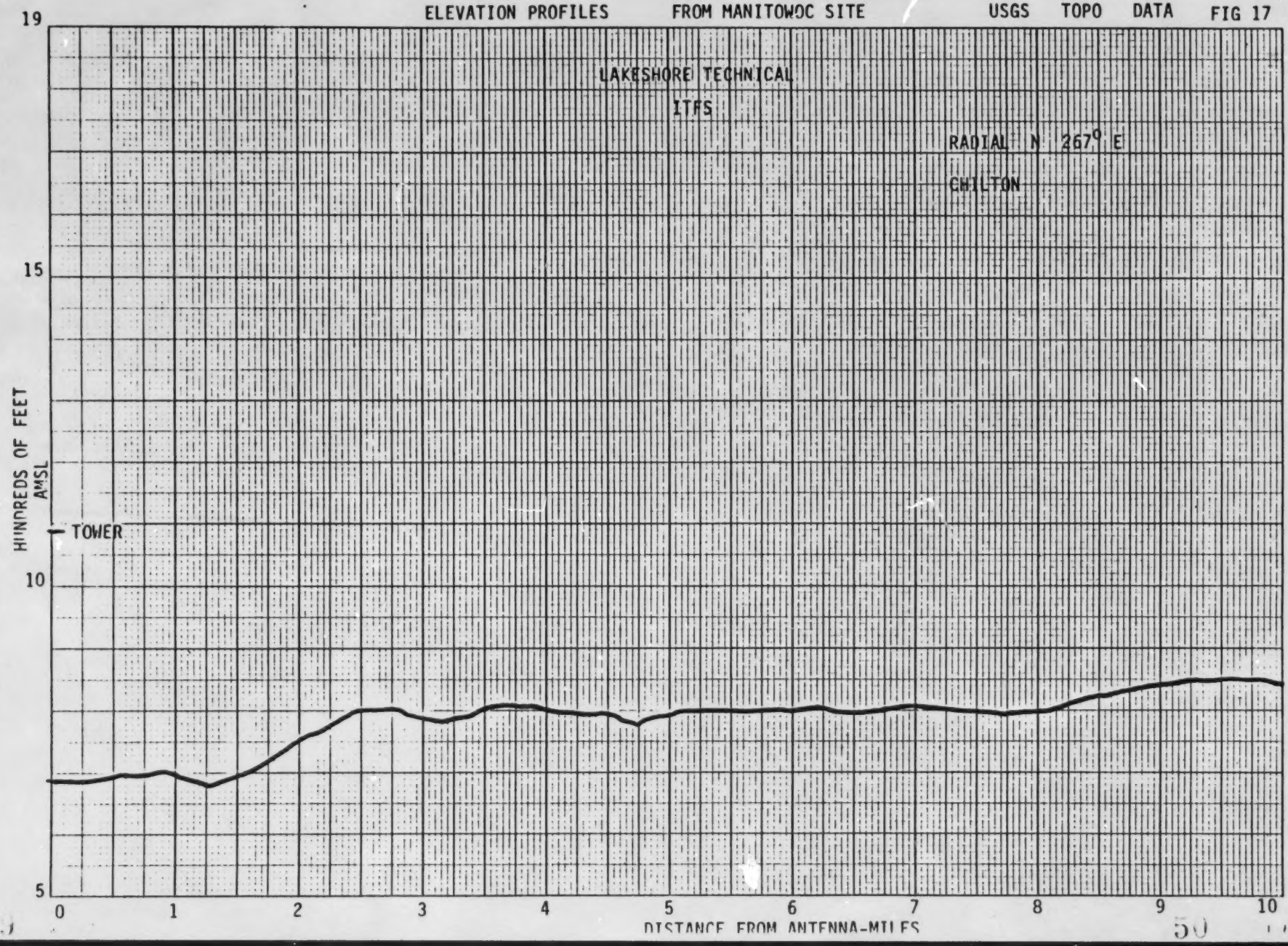
Chilton Site

CITY	DIST. FROM TOWER	AZ. FROM TOWER	DISH DIA.	SUPPORT HT.	REMARKS
Brillion	15.5 mi.	N 47° E	8 ft.	50'	No terrain obstructions Comm. Elev.: 880' AMSL
Chilton	6.8 mi.	N 90° E	6 ft.	50'	No terrain obstructions Comm. Elev.: 840-860' AMSL
New Holstein	11.9 mi.	N 119° E	8 ft.	50-75'	Terrain unfavorable Comm. Elev.: 950-1000' AMSL
Kiel	15 mi.	N 123° E	8 ft.	50-100'	Terrain unfavorable Comm. Elev.: 900' AMSL
Manitowoc	29.0 mi.	N 87° E	10 ft.	300'	No terrain obstructions

Tower height: 1584 AMSL (456 AGL) 44°-01'-50" 88°-17'-13"

K•E 20 X 20 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO MADE IN U.S.A.

46 1240



K·E 20 X 20 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO MADE IN U.S.A.

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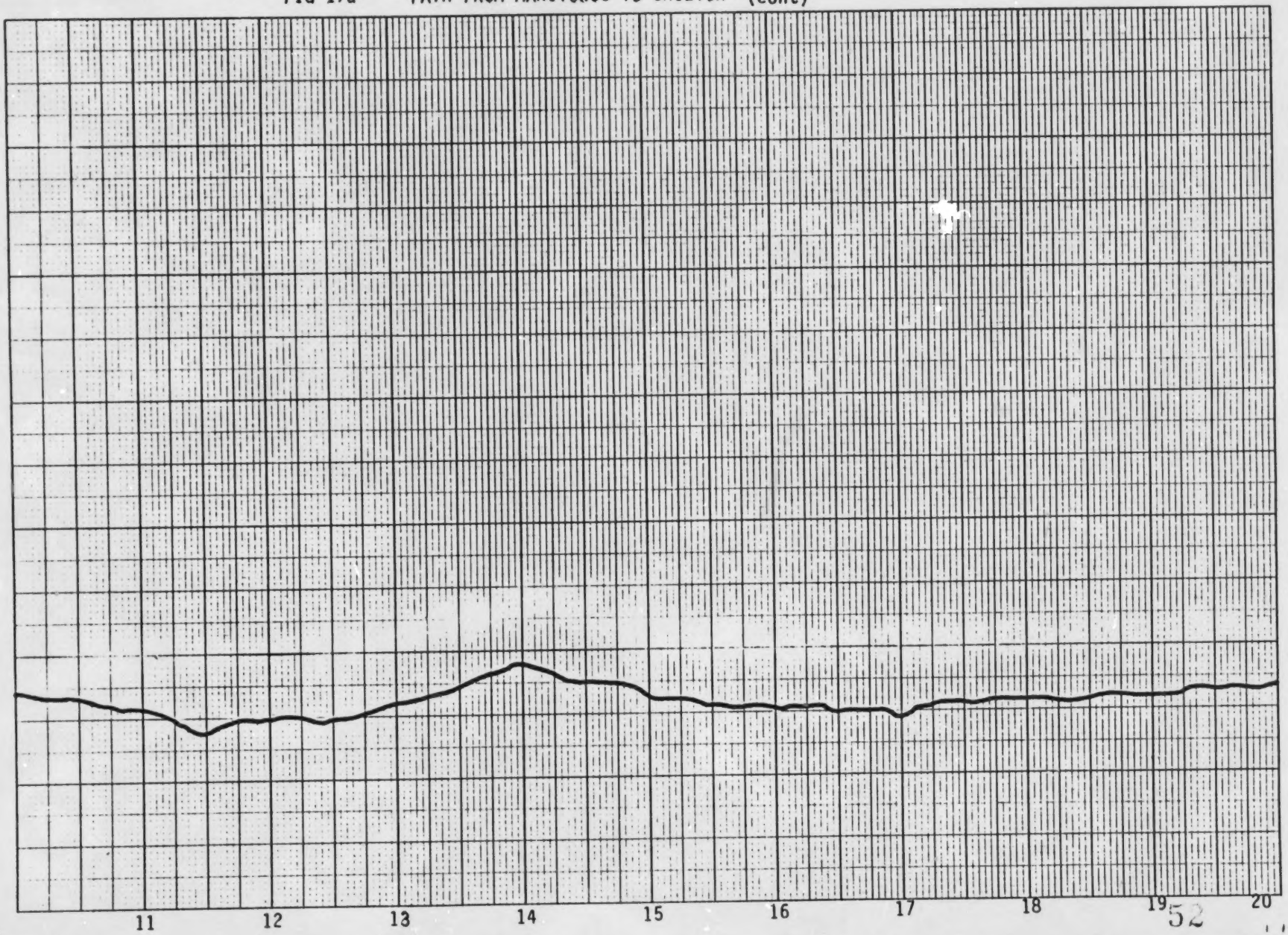
FIG 17a PATH FROM MANITOWOC TO CHILTON (cont)



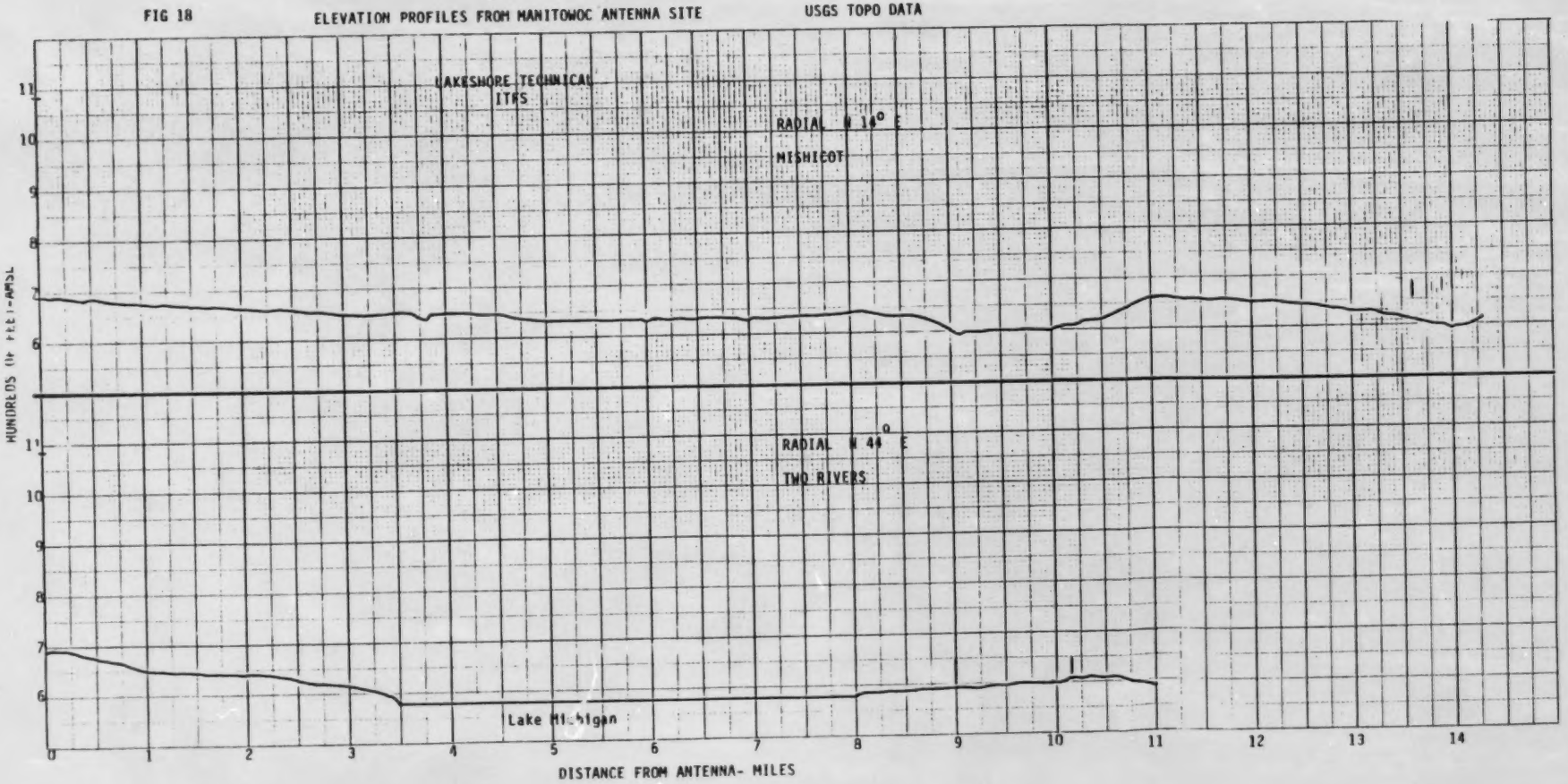
K·E 20 X 20 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO MADE IN U.S.A.

FIG 17b PATH FROM MANITOWOC TO CHILTON (cont)

K-E 10 X 10 TO THE INCH 7 X 10 INCHES KEUFFEL & ESSER CO

46 1240

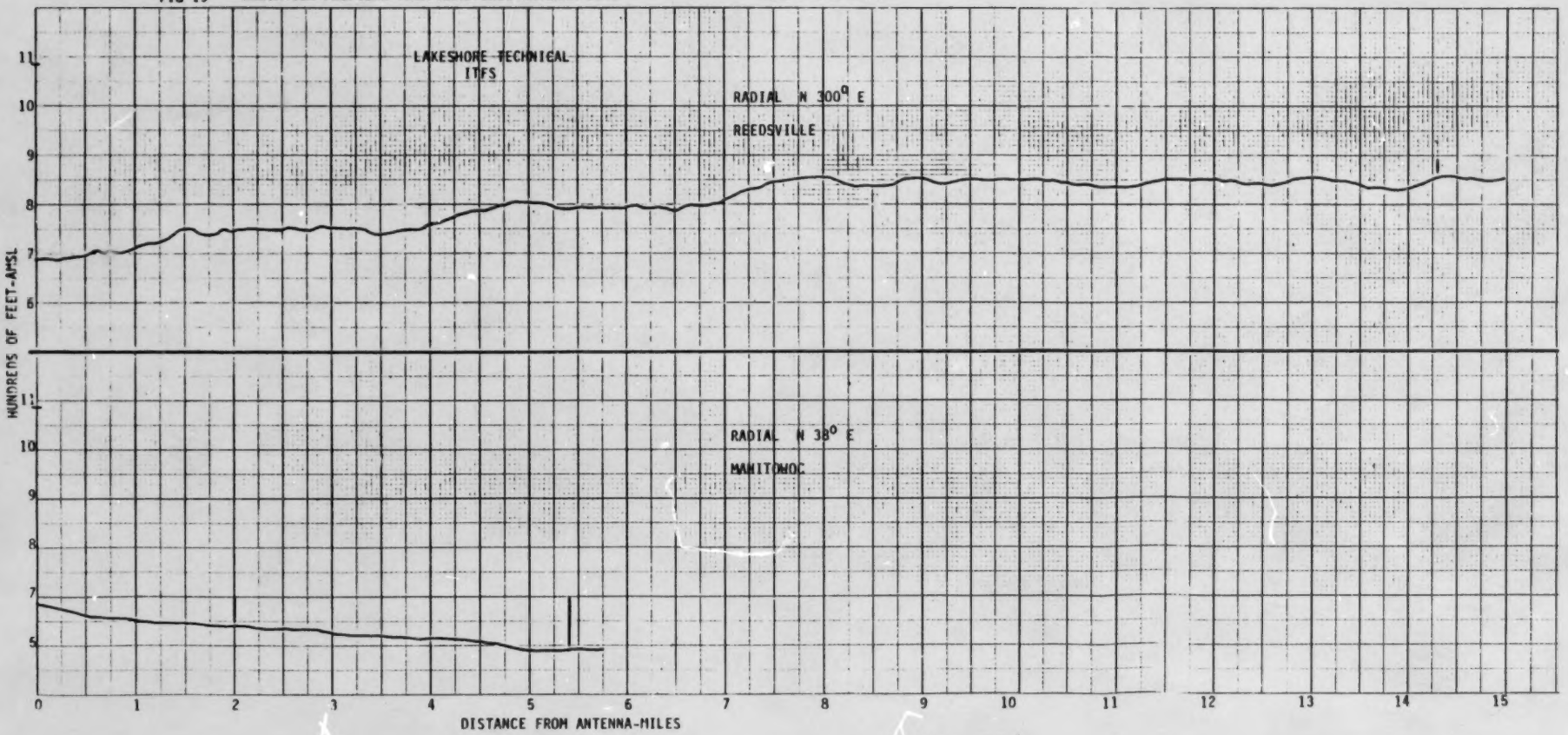
FIG 18 ELEVATION PROFILES FROM MANITOWOC ANTENNA SITE USGS TOPO DATA



55

46 1240

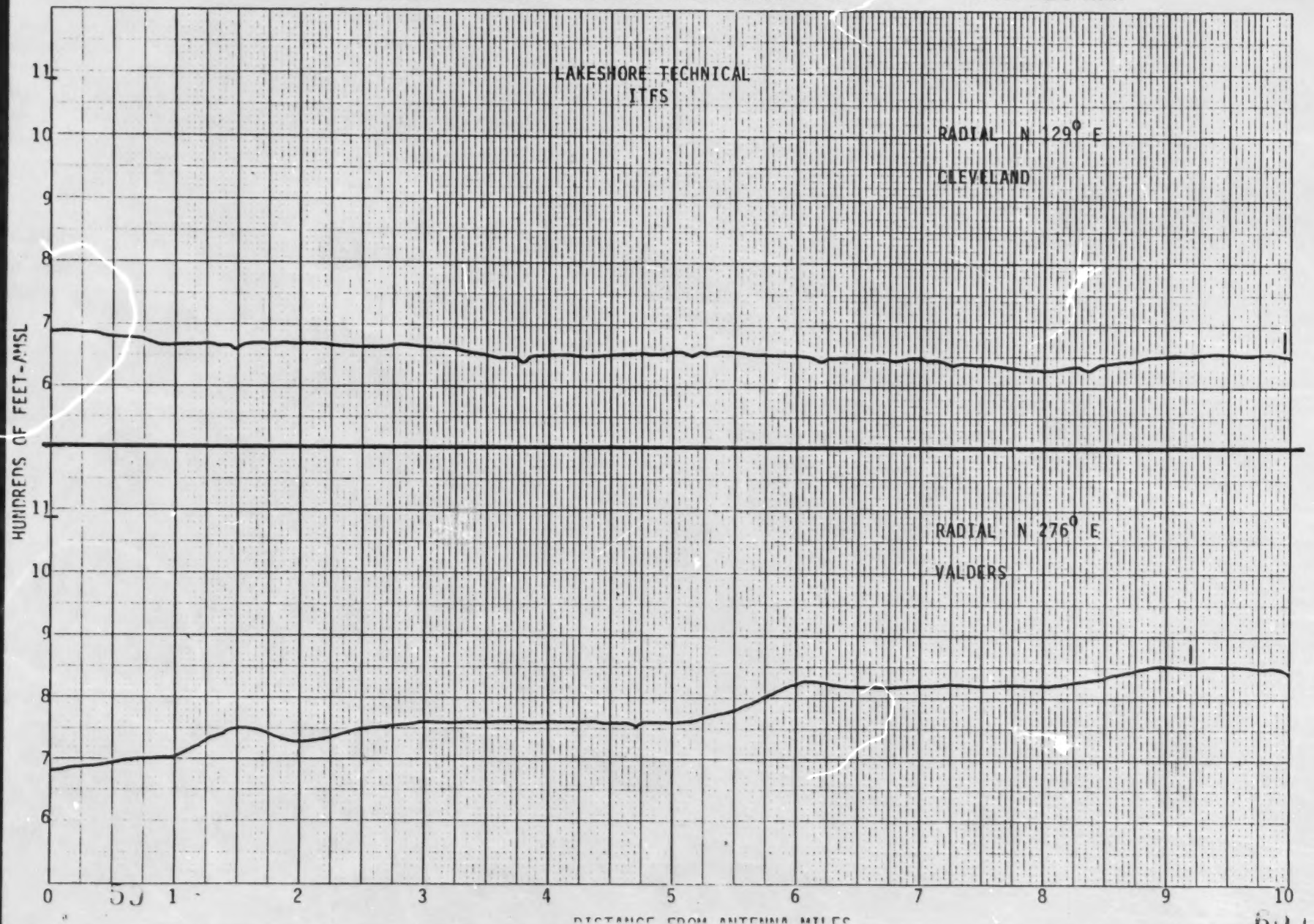
FIG 19 ELEVATION PROFILES FROM MANITOWOC ANTENNA SITE USGS TOPO DATA



20 X 20 TO THE INCH • 10 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.

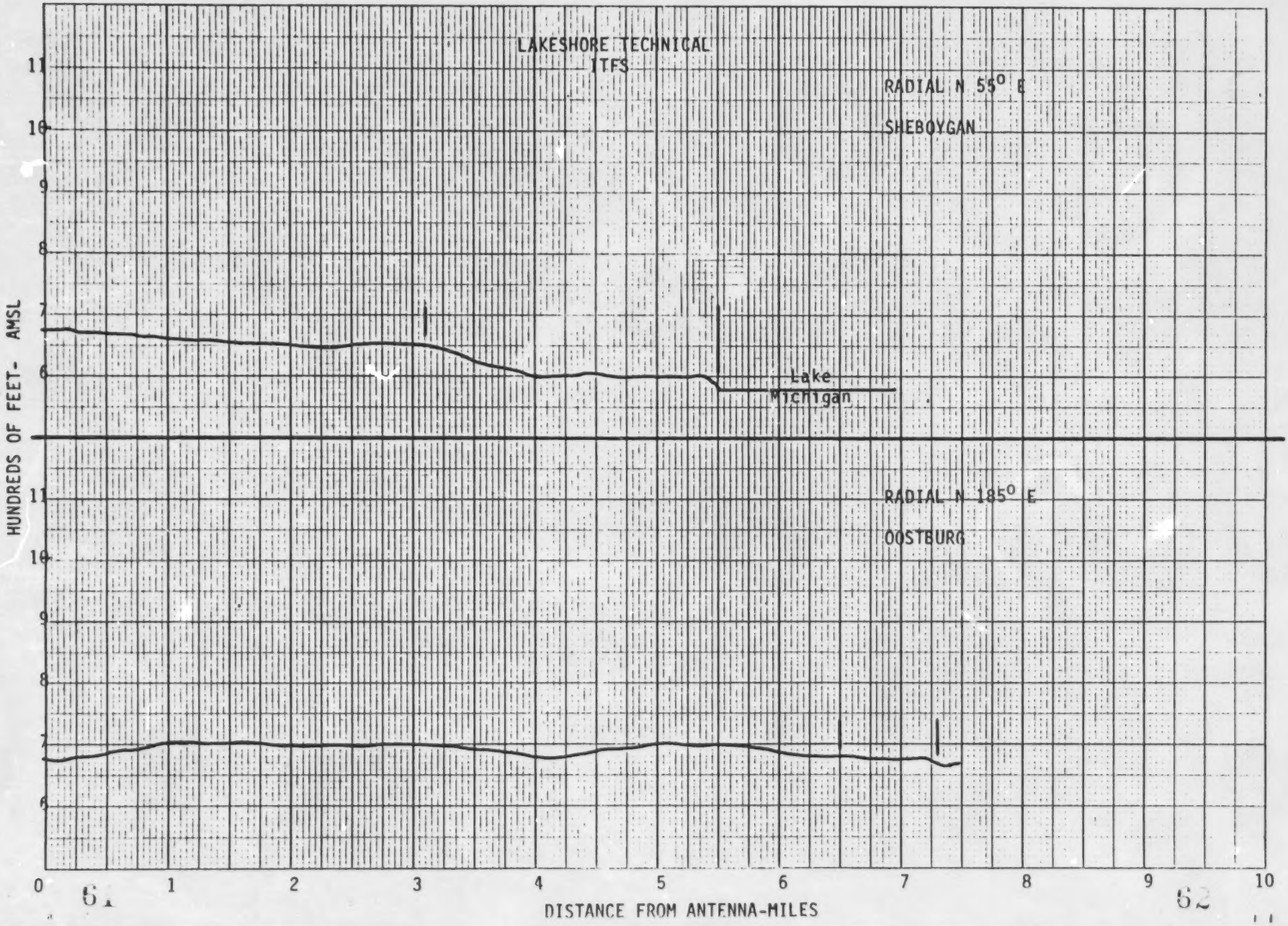
46 1240

FIG 20 ELEVATION PROFILES FROM MANITOWOC ANTENNA SITE USGS TOPO DATA



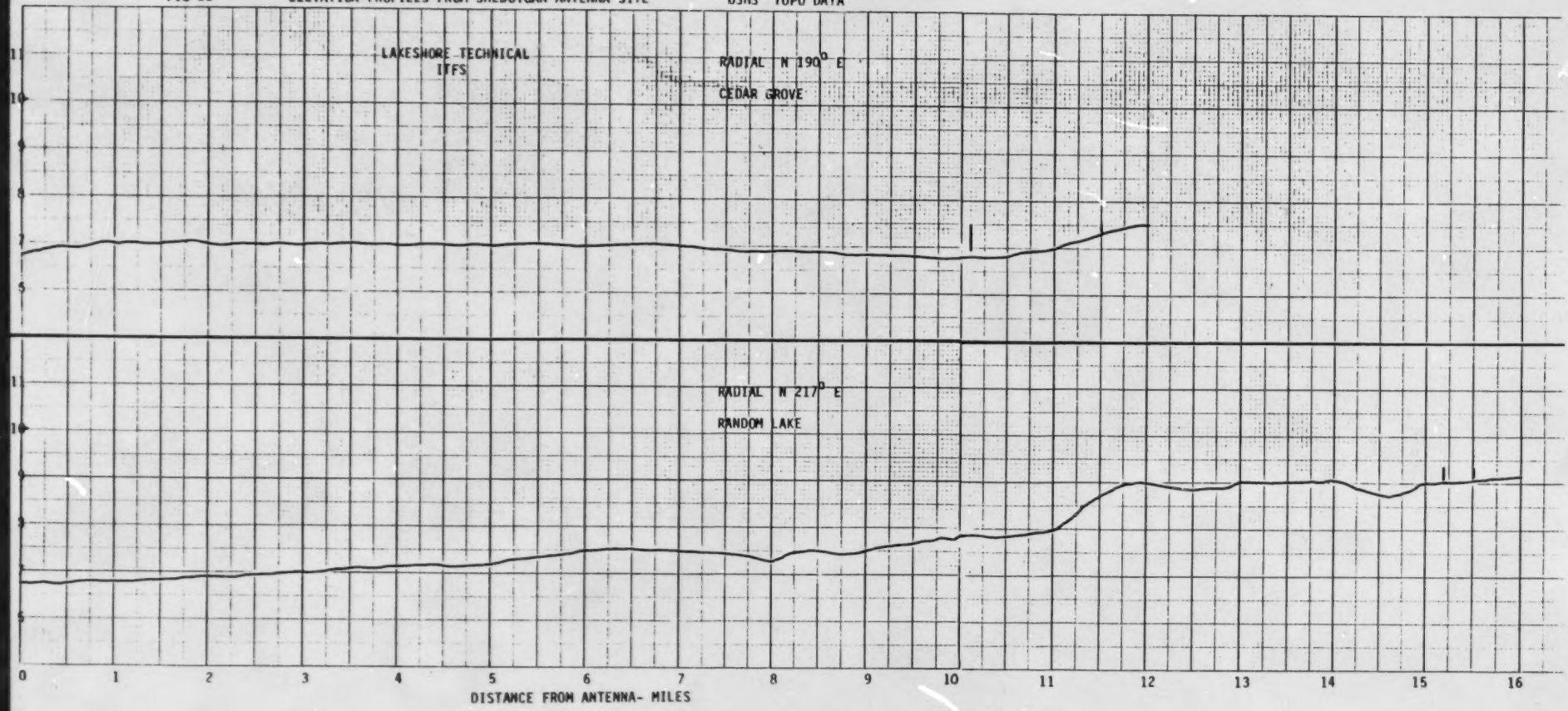
K•E 20 X 20 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO MADE IN U.S.A.

FIG 21 ELEVATION PROFILES FROM SHEBOYGAN ANTENNA SITE USGS TOPO DATA



46 1240

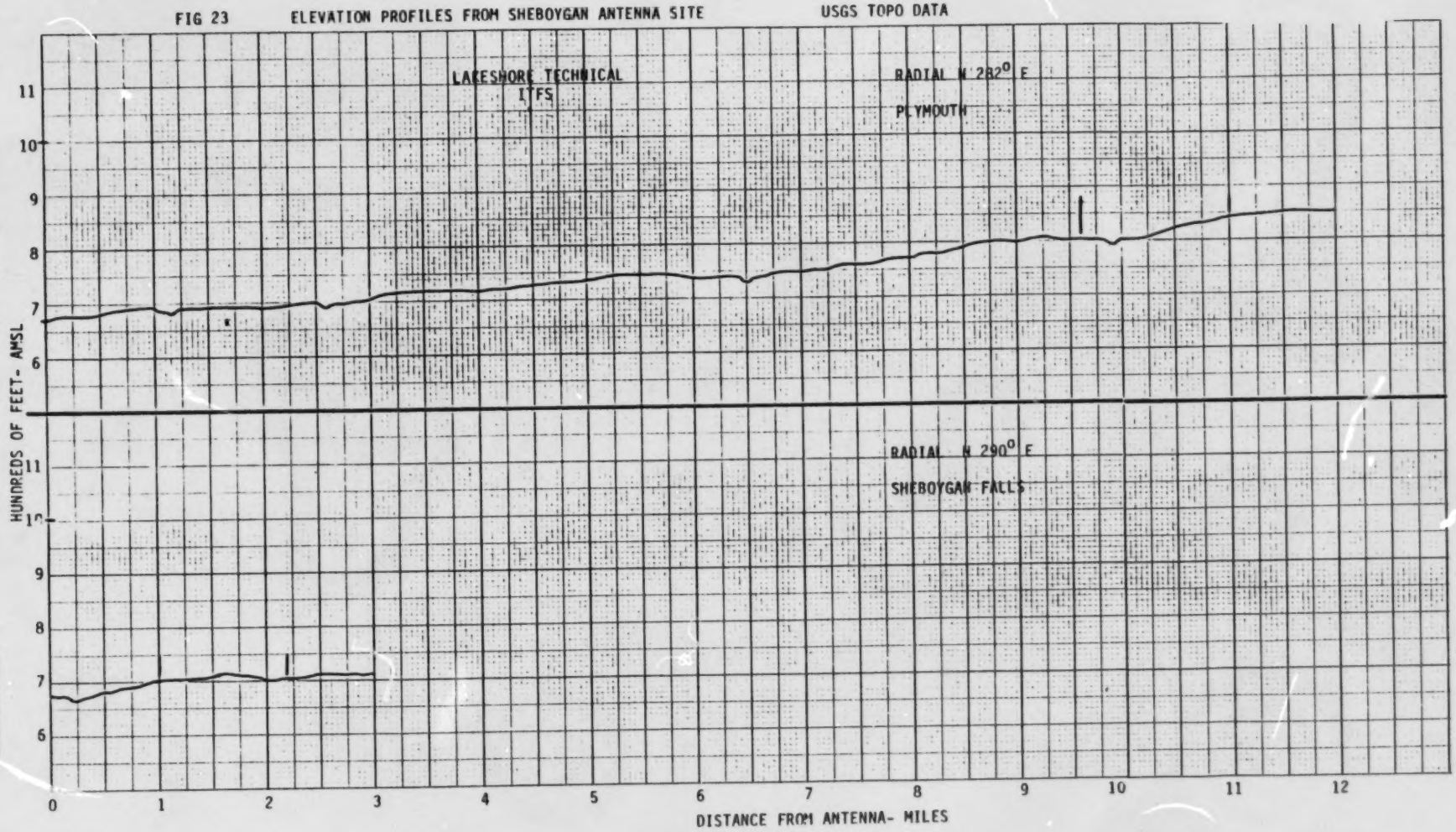
FIG 22 ELEVATION PROFILES FROM SHEBOYGAN ANTENNA SITE USGS TOPO DATA



K-E 25 X 22 TO THE INCH • 5 X 5 CYCLES
KEUFFEL & ESSER CO

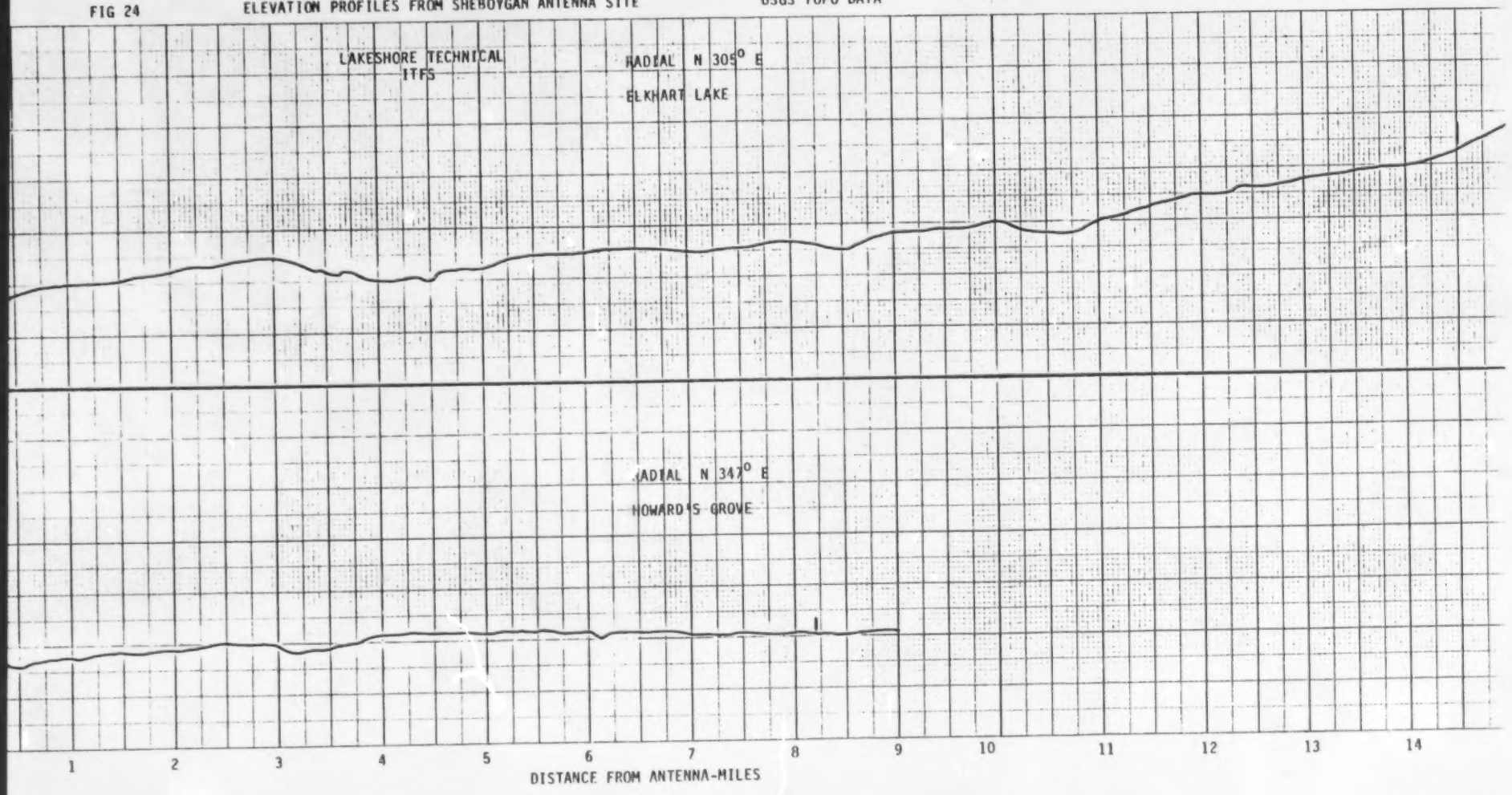
46 1240

FIG 23 ELEVATION PROFILES FROM SHEBOYGAN ANTENNA SITE USGS TOPO DATA



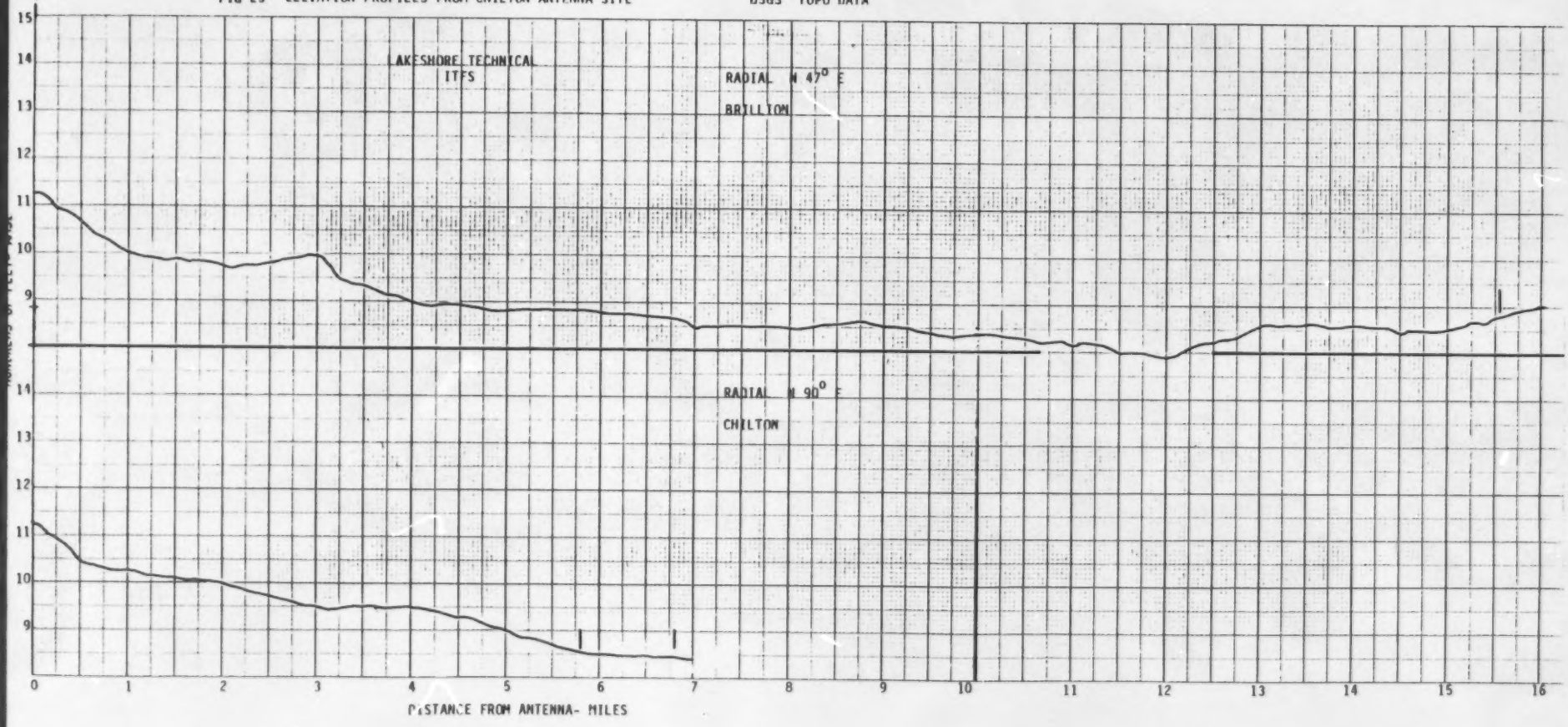
K-E 46 1240

FIG 24 ELEVATION PROFILES FROM SHEBOYGAN ANTENNA SITE USGS TOPO DATA



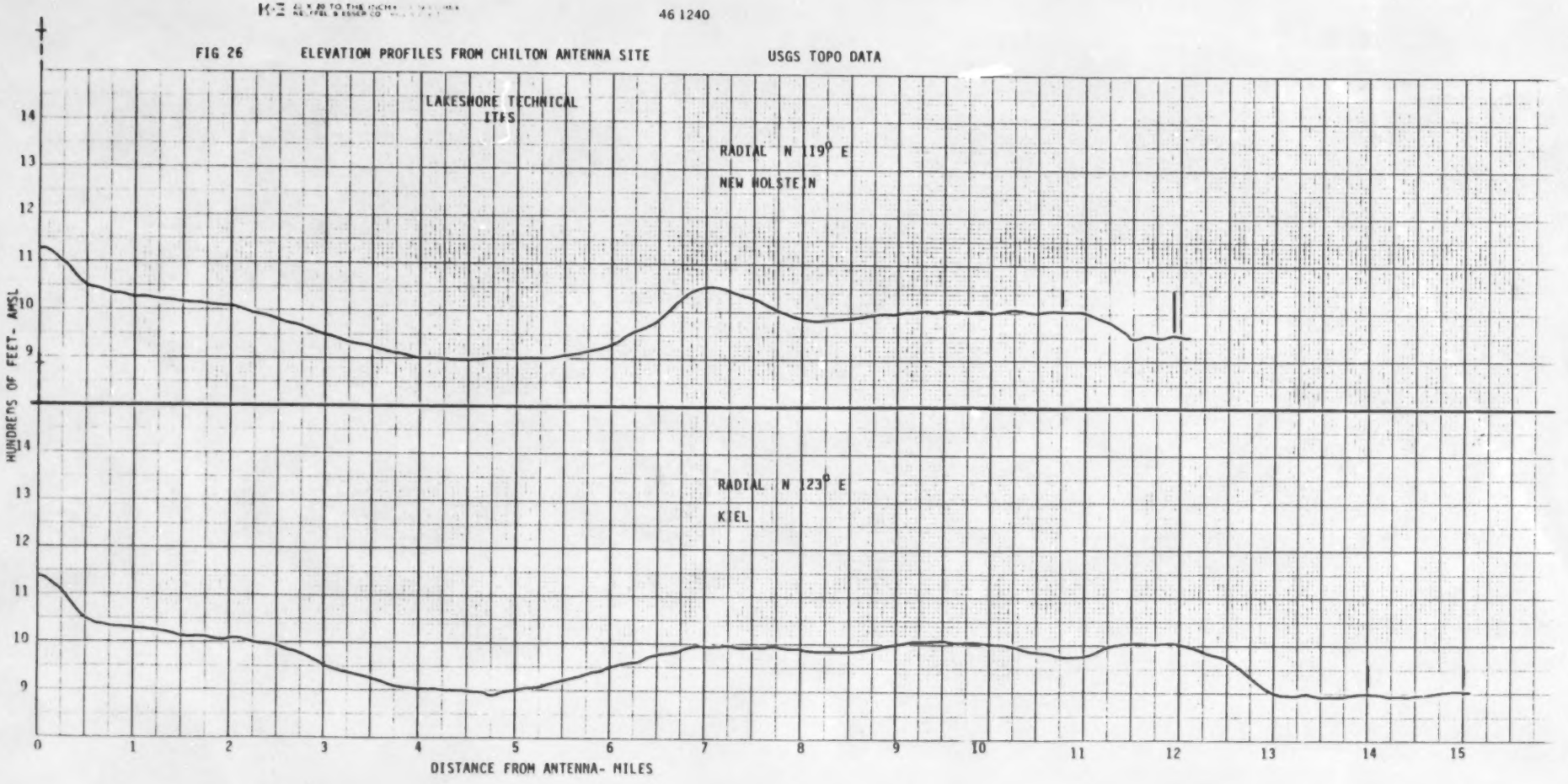
46 1240

FIG 25 ELEVATION PROFILES FROM CHILTON ANTENNA SITE USGS TOPO DATA



46 1240

FIG 26 ELEVATION PROFILES FROM CHILTON ANTENNA SITE USGS TOPO DATA



SPECIFICATIONS

FIGURE 28

RECOMMENDED LOW-WIND-LOAD ANTENNAS

LAKESHORE TECHNICAL INSTITUTE

(FOR POINT-TO-POINT 2.6 GHz.)

diameter	model	gain dbi	B/W	F/B db	SWR		WIND LOAD grid	WIND LOAD solid
2500 – 2700 MHz (Specify Frequency)								
4'	P-2548GR	28.0	6.6°	32	1.3	*	200	480
6'	P-2572GR	31.4	4.4°	36	1.3	*	430	1070
8'	P-2596GR	33.9	3.3°	38	1.1	*	850	1910
10'	P-25120GR	35.8	2.70°	44	1.1	*	1200	2990
15'	P-25180G	39.3	1.80°	47	1.1	*	2065	6600

* Low VSWR available on application
** ⅞" EIA Pressurized Only
*** Solid parabolas also available

■ Add suffix "N" to model number for non-pressurized application. Type "N" female (UG-23) termination unless otherwise specified.

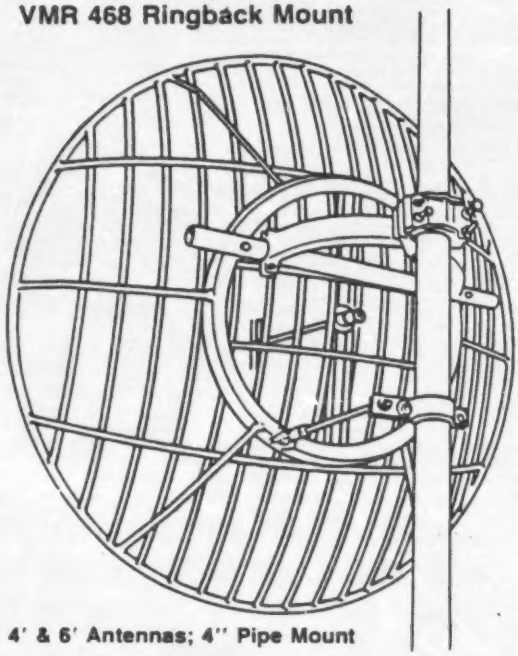
■ Add "/HC" to model number for heated grid application.

■ "X" and "T" back frames available on request.

FIGURE 29

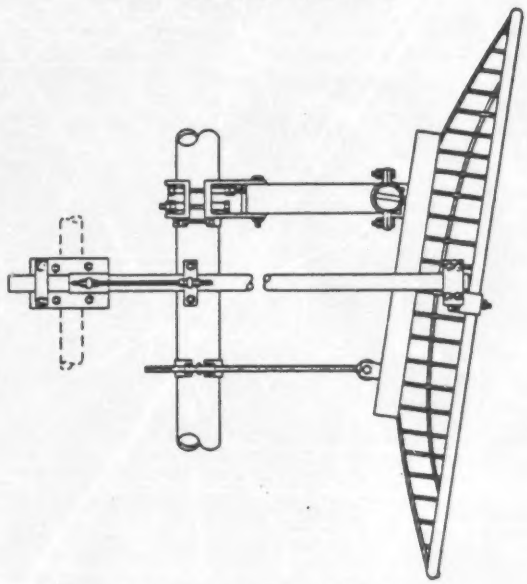
ANIXTER-MARK MOUNTINGS

VMR 468 Ringback Mount



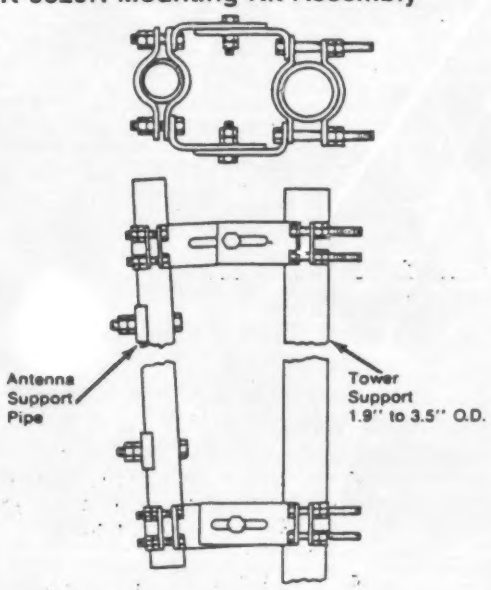
4' & 6' Antennas; 4" Pipe Mount

VMR 468-10 Ringback Mount



8' & 10' Antennas; 4" Pipe Mount

K-9629R Mounting Kit Assembly



4' thru 10' Antennas; 1.9" to 3.5" O.D. Pipe

Recommended Mounting Hardware

Antenna Size	1.9"-3.5" Pipe Mount	
	Mount	Side Brace
4'	1 ea. K-9629R	
6'	1 ea. K-9629R	2 ea. KBR-5
8'	1 ea. K-9629R	2 ea. KBR-8
10'	1 ea. K-9629R	2 ea. KBR-10
15' (Not a ringback)	1½ K-9629	6 ea. KB-12

(Add M-1 to model number when ordering.)

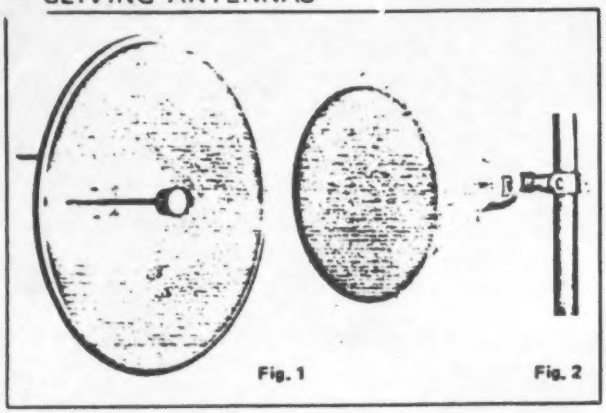
	4" Pipe Mount	
4'	1 ea. VMR-468	
6'	1 ea. VMR-468	2 ea. KBR-5
8'	1 ea. VMR-468-10	1 ea. KBR-8
10'	1 ea. VMR-468-10	1 ea. KBR-10
15' (Not a Ringback)	1 ea. VM4872PSP	6 ea. KB-12

(Add M-2 to model number when ordering.)

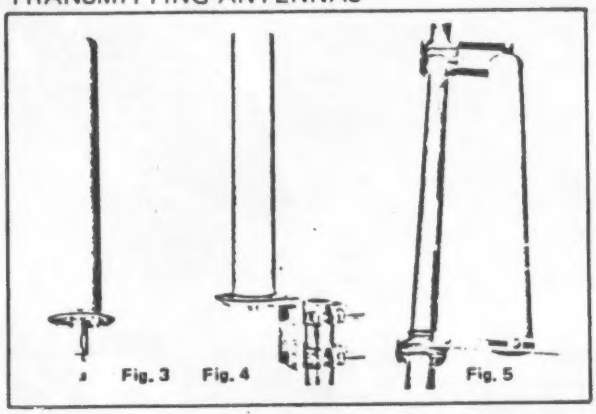
FIGURE 30

INSTRUCTIONAL TELEVISION ANTENNAS

RECEIVING ANTENNAS



TRANSMITTING ANTENNAS



Andrew offers a complete line of antenna systems equipment for the 2500 – 2700 MHz Instructional Television Fixed Service (ITFS). Our standard line of antennas is described on this page. For further information on antennas and antenna feeder systems refer to Bulletin 1056.

Transmitting Antennas will withstand winds up to 100 mph (160 kph) without damage. Included is mounting hardware for attachment to a 1 – 3 in. (25 – 75 mm) pipe for the omnidirectional types listed or a 4.5 in. (115 mm) pipe for the cardioid antennas listed. All antennas require pressurization and have a pressure rating of 10 lb/sq in. (0.7 kg/sq cm). Two directional antennas with opposite polarizations can be used to obtain omnidirectional coverage if a tower-top location is not available. Special radiation patterns and mounting arrangements are available on special order.

Receiving Antennas will withstand winds up to 100 mph (160 kph) without radome, and 115 mph (185 kph) with radome, with 0.5 in. (13 mm) of radial ice. Mounts are included. Type 63011 mounts to a 1 – 1.5 in. (25 – 37 mm) pipe. All others mount to a 4.5-in. (115 mm) pipe.

RECEIVING ANTENNAS

Frequency, MHz and Type	Type Number	Fig. No.	Aperture ft.	Gain, dBi ±0.2 at 2600 MHz	Beamwidth degrees Vertical	Beamwidth degrees Horizontal	VSWR Maximum	Order Radome Type	Output Type
2500 – 2700 Single Polarized	63011	2	1.4	18.3	19.0	21.0	1.3	64340	N Jack
	P4F-25†	1	4	27.6	7.0	7.0	1.3	LR4	N Jack
	P6F-25†	1	6	31.0	4.4	4.4	1.3	LR6	N Jack
	P8F-25†	1	8	33.8	3.3	3.3	1.3	R8E	N Jack
	P10F-25†	1	10	35.6	2.7	2.7	1.3	R10E	N Jack
2500 – 2700 Dual Polarized	60906-25(*)	1	6	31.3	4.1	4.1	1.25	R6C	N Jack
	60908-25(*)	1	8	33.8	3.3	3.3	1.25	R8E	N Jack

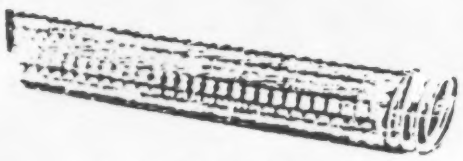
*Specify ITFS frequency group letter.
†Patented U.S. 3771161, Canada 979503, U.K. 1403298.

TRANSMITTING ANTENNAS

Frequency, MHz and Type	Type Number	Fig. No.	Polarization	Gain, dBi at 2600 MHz	Vertical Beamwidth Degrees	VSWR Max	Input Power, Watts	Input Type
2500 – 2700 Omnidirectional	56105-2(*)	3	Horizontal	9.6	13	1.25	100	N Jack
	62111A-(*) (**)	4	Horizontal	13.0	5	1.25	100	7/8" EIA
	58931-(*) (**)	4	Vertical	11.0	8	1.25	100	N Jack
	63013-(*) (**)	4	Vertical	13.0	5	1.25	100	7/8" EIA
2500 – 2700 Cardioid	62070A-(*) (**)	5	Horizontal	15.5	5	1.25	100	7/8" EIA
	62071A-(*) (**)	5	Vertical	15.5	5	1.25	100	7/8" EIA
	62350-(*) (**)	5	Horizontal	18.2	3	1.25	100	7/8" EIA
	62351-(*) (**)	5	Vertical	18.2	3	1.25	100	7/8" EIA

*Specify ITFS frequency group letter.
**Specify downward beam tilt (if required) in tenths of a degree.

HELIAX® ELLIPTICAL WAVEGUIDE AND CONNECTORS FIGURE 31



HELIAX ELLIPTICAL WAVEGUIDE

HELIAX elliptical waveguide is the optimum choice for most microwave antenna feeder systems. HELIAX is precision-formed and corrugated high-conductivity copper tubing with an elliptical cross section. The corrugated wall gives the waveguide excellent crush strength with light weight, good flexibility, and optimum stability. A rugged black polyethylene jacket provides protection during handling and installation. HELIAX is available in standard or premium (low VSWR) assemblies cut to a specified length or in bulk.

Connectors are transitions from the elliptical to rectangular cross sections and mate with standard waveguide flanges. Connectors are brass, except the 120 and 128 series, which are aluminum. A 1/8" female pipe thread pressure inlet, flange pressure rings, hardware and assembly instructions are included. Connectors can be attached in the field with standard hand tools.

WAVEGUIDE CHARACTERISTICS

Type	Operating Band, GHz	eTE_{11} Mode Cutoff Frequency, GHz	Major and Minor Dimensions Over Jacket inches (mm)	Bending Radii Minimum, Inches (mm) E-Plane	H-Plane	Recommended Twist degrees per foot (m)
EW20	1.9 – 2.700	1.60	5.02 x 2.83 (127.5 x 71.9)	26 (660)	71 (1800)	0.25 (0.75)
EW28	2.6 – 3.500	2.20	3.64 x 2.33 (92.5 x 59.2)	22 (560)	52 (1320)	0.25 (0.75)
EW37	3.3 – 4.300	2.81	2.90 x 1.86 (73.7 x 47.2)	17 (430)	41 (1040)	0.5 (1.5)
EW44	4.2 – 5.100	3.58	2.31 x 1.59 (58.7 x 40.4)	15 (380)	32 (810)	0.5 (1.5)
EW56	4.9 – 6.425	4.23	1.96 x 1.27 (49.8 x 32.3)	12 (305)	27 (690)	1 (3)
EW59	5.3 – 6.875	4.48	1.86 x 1.20 (47.2 x 30.5)	11 (280)	26 (660)	1 (3)
EW64	5.3 – 7.750	4.36	1.91 x 1.12 (48.5 x 28.4)	10 (260)	27 (685)	1 (3)
EW71	6.5 – 8.500	5.50	1.55 x 1.02 (39.4 x 25.9)	9 (230)	22 (560)	1 (3)
EW85	7.7 – 10.000	6.55	1.32 x 0.90 (33.5 x 22.9)	8 (200)	19 (480)	1 (3)
EW107	8.9 – 11.700	7.56	1.17 x 0.78 (29.7 x 19.8)	7 (180)	16 (400)	2 (6)
EW122	10.0 – 13.200	8.46	1.07 x 0.72 (27.2 x 18.3)	6 (150)	15 (380)	2 (6)
EW132	11.0 – 15.250	9.33	0.96 x 0.61 (24.4 x 15.5)	5 (130)	14 (360)	2 (6)

CONNECTORS*

Waveguide Types	Connector Types	Mates with U.S. Flange Types	Mates with IEC Flange Types	Dimensions, In. (mm) Length	Width
EW20	120E	CPR340G	PDR26	5.8 (147)	6.2 (157)
EW20	120R	7/8" EIA (with gas barrier)	–	9.0 (229)	4.4 (111)
EW20	120R-3	7/8" EIA (without gas barrier)	–	9.0 (229)	4.4 (111)
EW28	128AE	CPR284G	PDR32	12.7 (322)	5.0 (127)
EW37, EWP37	137CE, 137CET	CPR229G	PDR40	6.4 (161)	4.6 (117)
EW44, EWP44	144AC, 144ACT	UG-148/U, UG149/U	CAR48, UAR48, PAR48	8.4 (213)	3.1 (79)
EW56, EWP56	156BE, 156BET	CPR159G	PDR58	5.8 (148)	3.4 (85)
EW56, EWP56	256BC, 256BCT	UG-343B/U, UG-344/U	CAR70, UAR70, PAR70	6.0 (148)	3.4 (85)
EW56, EWP56	256BE, 256BET	CPR137G	PDR70	6.0 (153)	3.4 (85)
EW59, EWP59	159BC, 159BCT	UG-343B/U, UG344/U	CAR70, UAR70, PAR70	5.8 (148)	3.3 (83)
EW59, EWP59	159BE, 159BET	CPR137G	PDR70	5.8 (148)	3.3 (83)
EW64, EWP64	164BC, 164BCT	UG-343B/U, UG-344/U	CAR70, UAR70, PAR70	5.4 (136)	3.3 (83)
EW64, EWP64	164BE, 164BET	CPR137G	PDR70	5.4 (136)	3.3 (83)
EW64, EWP64	264BE, 264BET	CPR112G	PDR84	5.3 (133)	3.3 (83)
EW71, EWP71	171AC, 171ACT	UG-52B/U, UG-51/U	CBR84, UBR84, PBR84	4.4 (111)	2.4 (60)
EW71, EWP71	171AET	CPR112G	PDR84	4.4 (111)	2.4 (60)
EW85	185AC	UG-40B/U, UG-39/U	CBR100, UBR100, PBR100	4.6 (118)	2.1 (52)
EW107, EWP107	1107BE, 1107BET	CPR90G	PDR100	3.8 (97)	2.3 (58)
EW122, EWP122	1122C, 1122CT	WR75 choke or cover	–	4.1 (104)	2.0 (51)
EW132	1132C	UG-419/U, UG-541/U	–	4.3 (109)	2.1 (52)

*Covered by one or more of the following patents: U.S. 3,336,543, 3,461,409, and 3,818,383, Canada 827,800, 846,968, and 989,026, U.K. 1,091,697, 1,205,416, and 1,415,612, West Germany 1,491,901, and 1,791,249, Australia 418,835, France 1,482,318, Italy 770,599, others pending.

FIGURE 27

RALPH E. EVANS ASSOCIATES
Tele Communications Engineers

Budgetary Cost Estimates

LAKESHORE TECHNICAL INSTITUTE ITFS SYSTEM

I. OPTION 1 - Three-site one-way System

1. MANITOWOC SITE

a. 450' Tower - materials & Labor	$59,000
b. ITFS Transmitting Equipment	$51,000
c. Block Building & Environmental Control	$ 7,500
d. Remote Control Equipment & AC wiring	$30,000
e. Microwave Equipment for Chilton Link	$60,000
f. Audio Equipment	$15,000
g. Miscellaneous & Engineering	$10,000
TOTAL THIS SITE	$232,500

2. SHEBOYGAN FALLS SITE

a. 330' Tower - materials & Labor	$35,000
b. ITFS Transmitting Equipment	$51,000
c. Block Building and Environmental Control	$ 7,500
d. Remote Control Equipment	$30,000
e. Audio Equipment	$ 3,000
f. Miscellaneous & Engineering	$ 7,000
TOTAL THIS SITE	$133,500

3. CHILTON SITE

a. Tower Modifications and Labor	$25,000
b. ITFS Transmitting Equipment	$51,000
c. Building	$ 7,500
d. Remote Control Equipment	$30,000
e. Manitowoc Microwave Link Equipment	$50,000
f. Audio Equipment	$ 5,000
g. Miscellaneous & Engineering	$10,000
TOTAL THIS SITE	$178,500

4. CABLE CARRIAGE FEES: Local Cable TV Companies will be used for accomplishing the 2-way interconnection from Cleveland to Manitowoc, and from Cleveland to Sheboygan Falls. Uplinks from Kiel and New Holstein also must be provided via local Cable Company.

   THE PRICE FOR THESE ITEMS IS UNKNOWN. The applicant (LTI) must enter into negotiations with the cable companies involved and obtain rates based upon anticipated usage.

5. RECEIVING SITE COSTS

a. Antenna and Tower (Median)	$ 2,300
b. Down Converter	$ 1,000
c. School wiring and outlets	$ 1,500
d. Engineering Costs	350
e. Color TV set and cart	500
TOTAL COST THIS ITEM (EACH SITE)	$ 5,650
TOTAL COST FOR 16 LOCATIONS	$90,400

TOTAL BUDGETARY COST FOR OPTION #1: $634,900.00

II. OPTION #2

ADD UPLINK CAPABILITY TO OPTION #1 FOR FULL SYSTEM 2-WAY INTERACTIVITY FOR THE FIVE MAJOR COMMUNITIES

1. 12 GHz. Upstream Microwave transmitters for Sheboygan, Plymouth, Manitowoc, Two Rivers and Chilton @ $7,500 each	$37,500
2. Antennas, waveguide and associated labor @ $10,000 each	$50,000
3. Microwave receivers and antennas, plus labor and engineering @ $18,000 each	$90,000
4. Uplink Microwave Equipment for Chilton to Manitowoc	$60,000
TOTAL EXTRA COST FOR OPTION #2:	$237,500
TOTAL BUDGETARY COST OF PROJECT WITH OPTION #2:	$872,400

RALPH E. EVANS ASSOCIATES
Tele Communications Engineers

III. OPTION #3

DELETE Manitowoc and Chilton Sites, and install one 450 foot tower at the Lakeshore campus at Cleveland, Wisconsin, to cover the following communities with a single OMNI ITFS:

1. Sheboygan
2. Sheboygan Falls
3. Plymouth
4. Howards Grove
5. Kiel
6. Valders
7. Manitowoc

a. Delete Sheboygan Falls	- $133,500
b. Delete Chilton Site	- $178,500
c. Delete 9 Receive Locations	- $ 50,850
TOTAL FOR OPTION #3:	- $362,850
TOTAL BUDGETARY COST FOR PROJECT WITH OPTION #3:	$272,050

IV. OPTION 3a

Add uplinks to 3 Communities for Option #3 above	$106,500
TOTAL BUDGETARY COST FOR PROJECT WITH OPTION #3a:	$378,550

RALPH E. EVANS ASSOCIATES *Consulting Communications Engineers*
216 North Green Bay Road • Suite 208 • Thiensville, Wisconsin 53092
Telephone: 242-6000 (Area Code 414)

April 27, 1982

Mr. Jerry Richter
Rice-Richter Associates
1346 Connecticut Avenue N.W.
Washington, D.C. 20036

Dear Jerry:

Enclosed please find the detailed cost estimates you requested regarding the Lakeshore Technical Institute ITFS project.

As you can see, the prices are not exactly the same since we deleted the Chilton ITFS transmitter - this has a chain effect on some of the other equipment as well. I have included the microwave link over to Chilton as an option, however. This link could as easily be the other way (from Chilton TO Manitowoc); the cost would be the same.

If you wish to specify only ONE site, it would be either at Sheboygan or on the campus, but the cost would be that of the Manitowoc site.

If you have any questions, Jerrry, please call.

Regards,

Ralph E. Evans III

III
lti price breakout

MANITOWOC SITE DETAILED COSTS

1.	450' ALLIED microwave tower (special) Materials & labor erected on site	$59,000
2.	Tower labor to install ITFS antenna and waveguide (via: Tower Erectors, Inc .)	2,800
3.	EMCEE TTS-10F ITFS transmitter	$20,700
4.	ANDREW 63013 ITFS antenna	5,500
5.	MARTI RMC-20 Remote Control System	3,245
6.	ANDREW waveguide components for ITFS	
	450' EW-20 waveguide	8,190
	120R flange	700
	120R-3 flange	680
	34759-72 hoisting grip	72
	5-409939-10 grounding kits (5)	260
	858-C pressure kit	190
	317-66-10 waveguide clamp kits (15)	795
	317-68A tower adaptors (15)	660
7.	Miscellaneous hardware, parts, building appurtances, & relay racks (various vendors)	5,000
8.	Building to house electronic equipment	7,500
9.	Singer 20,000 BTU heater installed & wired	1,800
10.	Fedders 17,500 BTU air conditioner installed & wired	1,400
11.	Trade labor for AC wiring and connection of electronic equipment	5,800
12.	Supervisory, legal, and engineering fees	5,000
13.	Test Equipment	
	Hewlett-Packard 5342A frequency counter	4,500
	Hewlett-Packard 1741A storage scope	4,250
	Simpson 303 V-O-M	237
14.	Miscellaneous electronic parts, amplifiers, equalizers, and supplies	3,500

15.	1 lot SEARS hand tools	950
16.	TRANSTECTOR ACP-1000-120S lightning protector	1,230
17.	TEKTRONIX 528 waveform monitor	1,635
18.	POTOMAC INSTRUMENTS AA-1 audio generator and analyzer	1,495
19.	Utility charges to run AC power, telephone, and CATV to site	1,750
20.	Land costs	$24,000
	TOTAL COSTS FOR THIS SITE	$172,839.00

NOTE: Items 13, 15, 17, and 18 are <u>not</u> to be duplicated if other sites are to be added.

OPTION: To add microwave link from Manitowoc to Chilton Tower:

1.	MICROWAVE ASSOCIATES MA-12G transmitter installed	$25,000
2.	350' ANDREW WC-109 waveguide, installed (Manitowoc tower)	9,500
3.	350' ANDREW WC-109 waveguide, installed (Chilton tower)	9,500
4.	Two ANIXTER-MARK P-25120GR antennas	4,754
5.	MICROWAVE ASSOCIATES MA-12G receiver installed	10,500
6.	Engineering costs	4,000
10.	Miscellaneous costs for hardware, racks, and site make-ready	9,000
	TOTAL Option	$72,254.00

NOTE: <u>No</u> ITFS interface equipment has been included in this option, since the Chilton ITFS equipment is to be DELETED.

RALPH E. EVANS ASSOCIATES
Tele Communications Engineers

SHEBOYGAN SITE

1.	330' ALLIED Tower	$35,000
2.	Items 2, 3, 4, 5, 7, 8, 9, 10, 12, 14, 16, and 19 (see Manitowoc)	65,225
3.	ANDREW EW-20 waveguide	6,370
4.	Waveguide components (see Item #6 under Manitowoc, above) for 330' Tower	3,200
5.	Land costs	24,000
	TOTAL THIS SITE	133,795.00

~~$~~ 378,000 +

APPENDIX 3

PTFP PROPOSAL NARRATIVE

PART IV--PROGRAM NARRATIVE

The mission of Lakeshore Technical Institute (LTI) is to provide lifelong vocational, technical, and adult education to all residents in Manitowoc County, Sheboygan County, and southeastern Calumet County, Wisconsin. The project proposed by LTI would be the first public telecommunications delivery system for the general public, institutions, and organizations in this predominantly rural area. The regional system will include a second public telecommunications service to Sheboygan, Manitowoc, and Two Rivers; however, the technical system to provide this second service is being funded by local cable companies at no cost to this grant.

A. Project Location and Service Area

This regional telecommunications system will service Manitowoc County, Sheboygan County, and southeastern Calumet County, Wisconsin, in which the following municipalities are located: Cleveland, Kiel, New Holstein, Chilton, Brillion, Plymouth, Kohler, Sheboygan Falls, and Howards Grove. (See Appendix 1 for maps of service area.) LTI in Cleveland would house the centrally located origination facility for the system interconnecting all cable television systems in the area, ITFS, and low-power television.

B. Need for Services

1. Need for specialized programming for minorities and special segments of the area's population (total estimated at 120,000). Target audiences are listed below:

Non-English speaking minorities. Migration of Indochinese and Hispanic people into the Lakeshore communities is on the increase. There is a definite need for highly visualized television programs to assist in environmental adjustment for these non-English speaking residents. The resettlement of Southeast Asian refugees in this area necessitates their access to programs in their own languages on such practical topics as buying a house. Language and cultural barriers also exist for Asians in the health care area--a subject which area health institutions rank as a priority for programming. While nationally distributed programs do exist concerning Asian and Hispanic settlement in urban areas, little exists on rural resettlement and its issues. Locally produced bilingual or native language programs, therefore, are needed to help provide solutions to problems which our Hispanic and Indochinese residents face.

Senior citizens. Older residents in this region often find themselves isolated due to poor health, economics, lack of transportation, and inclement winter weather. Since many seniors rely upon television for their information, it is important to deliver programs of interest to them on nutrition, relevant financial matters, community news and senior activities, and government aid available to people who need it. Local programming could assist isolated individuals to share community experiences and to get in touch with others through call-in programs. Programs on family issues and problems of losing one's spouse could assist these residents and their families to reflect on issues of particular importance to people in their later years.

Women. Changes in the economy are causing more and more women from rural and semirural areas to confront issues which may change their traditional values and identities. Programming is needed which will focus on job skills, making transitions to the work place, changing family relationships, coping with divorce, and coping with changes in rural American life.

2. Need for public broadcasting programs in the area. Rural residents desire to receive the high-quality programming shown over public television stations. The 3-county area is a fringe area for public television stations in Green Bay (Channel 38) and Milwaukee (Channel 10). Reception is inadequate for most of the rural communities in the target area.

3. Need for local programs. Some local programming was described above as necessary for minority and special audiences in the Lakeshore area. In addition, several types of interest groups, institutions, and organizations see production of local programs and other services vital to their success in reaching audiences. Results of an area communications ascertainment involving 36 organizations are provided in Appendix 2 with needs of several groups summarized here:

Health and social service providers need to use television to disseminate information on health, services, and related issues to English-speaking and non-English speaking residents.

Educational institutions, schools, colleges, and libraries see the need to produce and share locally made programs by students and faculty. A local program facility would stimulate students and faculty to acquire new media skills while providing programs of relevance to the area.

Local nonprofit service organizations. Many of these groups serve minorities, seniors, handicappers, and women in addition to the general public. As such, many indicate their willingness to produce local programs for their clients. Local shows could include a community events bulletin board; local news; bilingual programs; and shows on such topics as volunteerism, child abuse, insurance tips, retirement, and local events.

Local government. Telecasts of public hearings and city council meetings are seen by area officials as necessary to further the involvement of citizens in local decision making. Better telecommunications would result in on-the-job television training to firefighters on various shifts in several small communities who otherwise are required to leave their stations for training.

4. Need for better educational program delivery. There is a need to improve delivery of adult education courses to adults in this area who cannot attend evening courses in person--primarily the home bound, shift workers, and farmers. Colleges, schools, and libraries see a need for telecommunications interconnection within the area both to share educational materials with similar institutions and to eliminate the necessity of longer-distance travel by students and/or staff for advanced vocational and professional training. Improved course delivery would also aid school students unable to travel to schools during winter snowfalls.

Documentation of the above needs for service are provided by the needs assessment conducted under a PTFP planning grant (Appendix 2) and letters of local support for this project (Appendix 3). A sample program schedule illustrating how the above needs would be reflected by system programming is contained in Appendix 4.

Objectives of the Proposal

1. To provide public telecommunications service to 13 rural communities which cannot receive this programming through existing cable interconnections. Programs originating from LTI can be distributed only to cable systems in Manitowoc, Two Rivers, and Sheboygan at the present time.

2. To create an integrated system using low power, ITFS, and cable--a more cost-effective approach than using only one of these systems alone.

3. To provide additional production capabilities at LTI so that the facility can provide programming for the ITFS-Cable Network to provide the services described. (See Appendix 2 and 3.)

4. To provide a structure within which women and minorities can participate to a greater extent in the control and operation of this public telecommunications system, participate in programming decisions, and receive special programs geared to their interests and needs.

C. Description of the Approach to Implementation

Technical Plan:

(a) An ITFS transmitter in Sheboygan Falls would be installed. ITFS receivers would be located in schools in each of the rural communities serving Kohler, Elkhart Lake, Howards Grove, Plymouth, Sheboygan Falls, Oostburg, Cedar Grove, and Random Lake.

(b) A two-way microwave interconnect between Manitowoc and Chilton would provide the feed for the low-power transmitter to be licensed to the Educational Communication Board of Wisconsin (ECB), serving Chilton, Oshkosh, Appleton, Brillion, New Holstein, Kiel, Reedsville, and Valders. This interconnection would enable organizations and institutions to feed information back to the main distribution hub at LTI by means of a return signal to LTI via Manitowoc.

(c) Microwave would interconnect the system with the Sheboygan, Manitowoc, and Two Rivers cable systems. This will provide a second public television service in the area; however, the cost of this interconnection is being provided by the commercial cable companies and is not requested in this grant. These cities are major population areas, and it is important that this programming reaches them.

(d) LTI's production capability would be augmented by adding remote production equipment, switching equipment, and additional replay equipment to serve the system.

Further documentation of this plan can be found in a description of cable television in this area (Appendix 5), a technical feasibility study made possible by a planning grant from PTFP (Appendix 6), area cable ordinances (Appendix 7), and FCC applications for ITFS, microwave, and a satellite earth station (Appendix 8).

Financial Plan:

The LTI Board of Education has shown great interest in this project. Evidence is that they have allocated $ to match a PTFP construction grant and have

increased their staff to implement the project and operate the telecommunications system. Their 1982-83 budget reflects these increases.

In addition, area corporations and community organizations and institutions show willingness to provide additional funds and support for future programming.

The Educational Communication Board of Wisconsin will finance the low-power television station in Chilton and will provide the area system with programming through the state cable network. All of these efforts and contributions show tremendous local support. Due to PTFP planning grant, LTI was able to secure free interconnections with area cable systems in populated areas of the service area. A PTFP construction grant is needed to provide service to rural communities--a key component to successful implementation of a public telecommunications service reaching the largest percentage of residents in the area.

Community/Managerial Support:

(a) A Telecommunications Advisory Committee, established in 1981, is composed of eight members representing women, minorities, education, and government. This committee will provide continuing input regarding community needs, priorities, and operational policies. Significant numbers of women and minorities are members of this board and have been actively involved in the planning of this grant.

(b) The five-member staff of LTI Media and Telecommunications Service Department (two female, one Asian-American), supplemented by part-time staff, will provide management, operational, and training services. Members of community organization staffs will be trained to operate production equipment and to produce programming for the system.

(c) Interest, support, and participation by the community continues to be forthcoming in the planning of this system. Activities have included a community survey, information seminars on the project, public presentations on the plans, and discussions with over 20 additional groups. (See Appendix 9 for press coverage.)

Coordination with Other Telecommunications Entities:

LTI serves as a regional distribution center for state-sponsored cable programs. ECB has applied for a low-power transmitter. LTI would be responsible for operating the low-power station and for providing regional programming. LTI obtains program materials for cable distribution from WMVS/WMVT (Milwaukee), WPNE-TV (Green Bay), Texas Instrument Telecommunication Center (Texas), Virginia Fairfax County Library (Virginia), MAWTN Minority and Women's Telecommunications Network (San Francisco), and Asian/Pacific Women's Network (San Diego).

Programs made by and for Indochinese groups will be shared with other local, state, and national telecommunication entities, since there is a tremendous shortage of learning materials and programs for these new immigrants. Appendix 5 details the relationship of the LTI project to area cable systems.

D. Alternative Technologies

A full examination of alternative technology options appears in the technical study (Appendix 6) and Appendix 10. The technologies applied for have been chosen since they are most cost effective, result in the greatest coverage of the service area, and duplicate existing systems to a minimum.